American River Watershed Project, California

Long-Term Study

Ecosystem Restoration Plan for Flood Plain Resources in the Lower American River

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SECTION 1.0

INTRODUCTION

1.1 Purpose and Scope

This report documents the development of an ecosystem restoration plan for the American River Watershed Investigation. The purpose of this report is to describe the plan formulation process for identifying potential alternatives for restoration of flood plain habitats in the Lower American River ecosystem. This report is developed as a parallel, companion study for the American River Watershed Long-Term Study ecosystem effort for fisheries resources through water temperature reduction in the Lower American River and includes:

- descriptions of the setting and existing environment, including location, land use, and site conditions (without the proposed project);
- a summary of site-specific problems, opportunities, and constraints;
- planning criteria and restoration goals and objectives; and
- descriptions of potential restoration measures, including significance, benefits, and costs.

1.2 Mission and Vision of Ecosystem Restoration

Ecosystem restoration is one of the primary missions of the U.S. Army Corps of Engineers' (Corps') Civil Works program. The purpose of ecosystem restoration is to restore significant ecosystem function, structure, and dynamic processes that have been degraded. The intent of restoration is to reestablish the attributes of a naturalistic, functioning, and self-regulating system.

The Corps' mission of protecting, restoring, conserving, and managing ecological resources has taken on greater importance over recent decades. The Lower American River study is an example of evaluating habitat restoration opportunities as part of a broader regional water resources management program authorized by Congress.

The stated purpose of ecosystem restoration efforts is to comprehensively examine the problems that contribute to ecosystem degradation and to develop alternative means of solving these problems.

1.3 Background

1.3.1 Regional Context

Various forms of development in the Central Valley of California and American River watershed have significantly reduced the area of historical wetland habitat and contributed to the

steady decreases in waterfowl and other wildlife populations. Before the 1850s, the Central Valley supported approximately 4 million acres of wetlands, nearly 1 million acres of riparian woodland, and additional associated grassland habitat. These vast expanses of permanent and seasonal wetlands provided wintering and breeding habitat for many species of waterfowl and other wildlife species that flourished throughout the region. As the human populations increased, wetland, riparian, and other native habitats were reclaimed for agricultural, urban, and industrial uses. Between 1939 and 1985, wetlands and riparian woodland disappeared from the Central Valley at an average rate of 5,200 acres per year. Only approximately 379,000 acres, or 9 percent, of the original wetland acreage and 102,000 acres, or 11 percent, of the original riparian woodland acreage remained in 1985, Katibah 1984).

The loss of wetland and riparian habitat in the Central Valley has substantially reduced populations of many wildlife species, including waterfowl and other water birds, a variety of threatened and endangered species (e.g., bald eagle, greater sandhill crane, yellow-billed cuckoo, and Swainson's hawk), large mammals, (e.g., tule elk, pronghorn antelope, grizzly bear, and mule deer), and other wildlife species. Habitat loss has also contributed to the decline in other important values, including fisheries production, floodwater storage, groundwater recharge, sediment control, recreational opportunities, and aesthetic values.

1.3.2 Project Area

The combination of a century-and-a-half of mining, development, flood plain constriction, dam construction, and flow modifications have altered the physical processes that sustain ecosystem values, thereby contributing to significant degradation of the Lower American River ecosystem. Riverwide and site-specific conditions are described in detail in the following chapter. A summary of the problems and opportunities in this ecosystem is presented below.

Problem: High flood plains produced by deposition of sandy sediments from upstream hydraulic mining during the Gold Rush are disconnected from the ordinary flow of the river, except in very high flow events. Without a regular cycle of frequent inundation bringing water to the unnaturally high flood plains, native plant species cannot regenerate adequately.

Opportunity: Removing excess soil to reestablish more frequent inundation and a shallower water table would facilitate a more natural hydrologic cycle for native plant establishment and makes a larger area subject to frequent inundation. This would result in healthy, diverse riparian communities and overall habitat improvement.

Problem: Channel downcutting between the high flood plain banks results in a lack of shallow aquatic habitat along channel edges, which is important to juvenile fish rearing. It also results in a lack of shallow, slow-water side channels and other off-channel aquatic habitats that are important to both fish rearing and fish spawning.

Opportunity: High-quality fish rearing habitat can be created by cutting benches to lower bank elevation or by constructing shallowly submerged fill benches along channel edges,

together with placing instream woody material and planting riparian vegetation near the shoreline.

Problem: The dry conditions of the high flood plains and the modified hydrologic cycle allow invasive nonnative plants that are better adapted to these disturbed conditions to persist and spread. The system generally lacks vegetative cover and diversity.

Opportunity: Allowing for more frequent inundation, removing invasive nonnative species, and planting native riparian plants would improve ecological function.

Problem: Dredge tailings in the form of bars and deposits along the riverbanks and on the flood plain provide a poor substrate for riparian plants and less-than-optimal fish and wildlife habitat values. Upstream dams have eliminated transport of sediment downstream and slowed the development of substrate for plant colonization.

Opportunity: Removing and redistributing large river cobble, combined with reintroducing fine-grained bank material, may foster conditions more suitable for regeneration of native riparian vegetation.

Problems: Deep pools occur in several locations where the river captured abandoned gravel mining pits. These pools provide habitat for predator fish that prey on juvenile salmon.

Opportunity: Filling excessively deep pools, lowering the flood plain, developing side channels, and disposing of dredge tailings could eliminate predator habitat and increase juvenile salmon survival.

SECTION 2.0

SETTING AND EXISTING CONDITIONS WITHOUT PROJECT

2.1 General Setting

The American River originates in California's central Sierra Nevada. The North and Middle Forks join near the City of Auburn, California, before emptying into Folsom Reservoir, which is impounded by Folsom Dam. The South Fork also drains into the Folsom Reservoir. Releases from Folsom Dam enter Lake Natoma before being discharged into the Lower American River. The river below Lake Natoma is almost entirely regulated by flows from these two impoundments. The river joins the Sacramento River near downtown Sacramento. Water surface elevations (stage) in the lower reaches of the American River are strongly influenced by flows from the Sacramento River.

2.2 Location

The Lower American River includes the 23 river miles (RMs) between the Nimbus Dam and the river's confluence with the Sacramento River. The river is bounded in much of this reach by levees on both the north and south sides. Flood protection levees begin at the confluence with the Sacramento and extend to approximately RM 14 on the north bank and RM 11 on the south bank. The American River Flood Control Project levees are within the jurisdiction of the Corps, American River Flood Control District (ARFCD), Sacramento Area Flood Control Agency (SAFCA), and Reclamation Board of the State of California. These levees provide flood protection for the cities and communities of Rancho Cordova, Carmichael, Orangevale, Citrus Heights, Arden-Arcade, and Sacramento. These levees contain high-velocity flow that historically would spread over the now urbanized flood plain. Upstream of the project levees, the river is confined primarily by bluffs, although some private levees locally confine floodflows.

2.2.1 Land Uses

The American River Parkway (Parkway), owned and managed by Sacramento County, borders much of the river. The principal management document for the natural resources of the Lower American River is the American River Parkway Plan (Sacramento County Planning and Community Development Department 1985). The Parkway lies almost entirely in the Lower American River flood plain and is valued by local residents for its natural beauty and recreation resources. The Parkway encompasses approximately 5,000 acres of developed parkland (including multiuse trails, picnic areas, boating access, playgrounds, fishing ponds, and golf courses) and undeveloped natural areas (including wetlands, riparian habitat, upper flood plain habitats, and mine tailings). The Parkway is managed by the Sacramento County Department of Parks, Recreation, and Open Space (County Parks). Relatively small portions of the Parkway corridor are in private ownership, including the flood plain adjacent to the State of California State Fair and Exposition Center (Cal Expo) and the Urrutia mining pit. Near Arden Bar, the Sacramento County Sheriff's Department operates and maintains a training facility).

2.2.2 Existing Conditions

Physical Processes

In the 1860s and 1870s, hydraulic mining washed an unprecedented amount of sediment and mining debris into the American River. This debris caused excessive aggradation, or vertical accumulation of sediment, in the lower river channel and on the river's natural flood plain. This material effectively raised the low-flow elevation of the river as much as 40 feet (Ayres 1997). To protect farmland and urban development from flooding, levees were constructed on top of this unnaturally high flood plain. Subsequent construction of upstream dams in the watershed altered the natural sedimentation regime of the lower river by preventing transport of sediment that builds natural levees, flood plains, and point bars typical of low-gradient valley floor rivers. This condition is sometimes referred to as sediment deprivation and the result called a "hungry" or "sediment starved" river system.

Instream and flood plain sand and gravel mining in the early 1900s depleted much of the natural gravel and produced large areas of artificially deposited gravel, commonly known as dredge tailings. The combination of mining activities and levee and dam construction has resulted in the deepening of the river channel because sediment from the river bottom, transported to the San Francisco Bay-Delta, is not replaced by new sediment from upstream. The result is that these unnaturally high flood plains are inundated much less frequently.

These water management projects have had a significant effect on the Lower American River's ecology and wildlife, resulting in degraded habitats. One example is the widespread presence of relict stands of mature cottonwoods situated well above the present elevation of the 1.5- to 3-year flood. The absence of depositional river processes, including the formation of new gravel and sandbars, as well as the infrequency of inundation of the higher flood plains, has virtually eliminated the recruitment of new cottonwood stands along the river. (U.S. Fish and Wildlife Service 1991.

The lower 12 river miles of the American River can be subdivided into 3 reaches characterized by the differences in the interaction between the flood plain and the river channel, or its geomorphology. Reach 1, characterized by very little sediment storage in point bars and intermittently eroding banks, extends from the confluence with the Sacramento River at Discovery Park, or RM 0, to RM 4.8. This low-gradient reach encompasses the area influenced by the normal tidal backwater from the Sacramento River. Reach 1 is confined by Federal and State levees and has a relatively wide flood plain of approximately 2,000-3,000 feet wide between levees. The river primarily flows through a 500-foot-wide channel adjacent to the south levee. During floods on either the Sacramento or American River, the north flood plain is inundated. Three of the proposed restoration sites lie in this reach: Urrutia, Woodlake, and Bushy Lake.)

Reach 2, extending from RM 4.8 to RM 8.0, is a higher gradient reach confined by Federal and State levees and has a much narrower flood plain than Reach 1. The floodway

narrows from a width of approximately 2,000 feet at the downstream end to approximately 1,000 feet over much of the remainder of the reach. There were no restoration sites selected for this project in this reach.

Reach 3, extending from RM 8.0 to RM 11.5, is a higher gradient reach that is less confined by Federal levees that extend on the north bank to the end of the reach and on the south bank to RM 10.8. Several separate segments of levees built by private landowners exist along the south bank from RM 11 through the upstream end of the reach. The flood plain width varies from 1,000 feet to 1,500 feet. The Arden Bar restoration site is located in this reach, on the north bank.

Vegetation Resources

Native vegetation communities in the American River Parkway are principally found between the river channel and the levees and on natural bluff formations (U.S. Fish and Wildlife Service 1991). Distribution of wetland and riparian habitats is largely determined by the surface water and groundwater hydrology of the Lower American River. The alteration of the natural hydrologic processes, resulting in the dry characteristics of the high flood plains and the lack of development of new flood plains, has nearly halted the establishment of new native plant communities. As a result, the character of the native vegetation communities is continuing to respond and adjust to these changes in the physical environment (U.S. Army Corps of Engineers 1996).

Sanders (1985), Watson (1985), and, most recently, Jones & Stokes (1998) prepared by Hart have described vegetation of the Lower American River. Hart identified 18 habitat types and subtypes in the Lower American River corridor. For the purposes of this study, we have combined these vegetation types into more general habitat types, which are described below.

Freshwater Marshes. Freshwater marshes typically are found along river backwaters and urban drainage canals at the toe of the levees. This habitat type is usually intolerant of summer drought, wide fluctuations in water level, and fast-moving water. Marsh plants include tules, cattails, and, to a lesser degree, smartweed, rushes, and sedges, in water less than 5 feet deep. Sanford's sagittaria, a rare species and candidate for Federal listing as an endangered or threatened species, occurs in several marshes in the Lower American River. (U.S. Fish and Wildlife Service 1991.)

Seasonal Wetlands. Season wetlands typically are found on the higher flood plain as depressions that hold water long enough to exclude other riparian, woodland, or grassland species. Many of these depressions are natural; however, several are borrow sites for railroad and flood control levee repair or construction. Because these wetlands tend to be isolated from the main river channel, fish stranding is common. This occurs when the wetland is inundated by late winter and early spring flows that flush juvenile salmonids and steelhead downstream. When the waters recede, there is no outlet for the fish back to the river channel.

Cottonwood-Riparian Forests. Cottonwood-riparian forests are the natural habitat of flood plains of the river and serve as important sources of large woody material to the river, terrestrial insects that are important food of native fish and songbirds, and leaves that support the aquatic food web. Regeneration and maintenance of high diversity of this habitat type depends on periodic and low-intensity flooding during the seed-setting period, as well as sediment deposition and groundwater availability at relatively shallow depths. In the absence of natural sediment deposition and channel meandering, cottonwood recruitment has been virtually eliminated. Existing stands of old-growth cottonwoods are aging without opportunity for replacement (U.S. Army Corps of Engineers 1991). Moreover, flood plain development, fires, levee construction, and erosion during large floodflows continue the loss of existing riparian forest habitat along the American River. Areas that were historically dominated by cottonwoods are converting to mixed riparian forest stands.

Mixed Riparian Forest. Mixed riparian forest is commonly found above the areas experiencing frequent flooding and deposition and is able to regenerate through dropping seeds in existing stands. In riparian areas that are not presently susceptible to scour and floodflows but are adjacent to waterways, some in-stand regeneration is occurring. Much of the mixed riparian forest in the Lower American River includes nonnative tree and shrub species, such as black locust and Spanish broom. Along the river edge, alder stands are sustained and regenerating because of consistent summer flow. This is particularly evident at Arden Bar.

Valley Oak Woodlands. Valley oak woodlands are of great regional ecological importance because of their relative scarcity and high wildlife values (U.S. Fish and Wildlife Service 1991). These woodlands are mostly developed on the high flood plains, typically where older mixed riparian forest has senesced, allowing woodland species to dominate. These areas receive floodwaters infrequently, although woody vegetation is also supported by the relatively shallow groundwater associated with the American River (U.S. Army Corps of Engineers 1991). The canopy is typically open and dominated by valley oak, black walnut, elderberry, and an occasional old cottonwood.

Grassland. Grassland communities would normally occur outside the flood zone in areas that are now urbanized. Grasslands that exist in the floodway usually are associated with sites of recent human disturbance, including filling, mining, agriculture, levee construction, and burning, as well as with sites of frequent scouring. Dominant species include many nonnative species, including yellow star-thistle, brome, oat, fescue, filaree, and barley grasses. Native forbs are scarce in the grasslands. These areas would provide greater wildlife value if they remained actively farmed to reduce nonnative invasive species (U.S. Fish and Wildlife Service 1991). Excavating the nonnative seedbank and applying herbicides are other tools to control nonnative species in grasslands.

Wildlife Resources

More than 220 bird and 30 mammal species have been observed in the American River Parkway, U.S. Fish and Wildlife Service 1991). Forty-five bird species are also known to nest in riparian and wetland habitats found in the Parkway (Gerstung 1971). The Parkway supports

resident and migratory wildlife and is heavily used as a travel corridor (U.S. Fish and Wildlife Service 1991). Riparian habitats support the greatest diversity of wildlife because they support a greater diversity of plant species and vegetative structure—and consequently a greater number of habitat niches for wildlife—than other habitats in the Parkway. Freshwater marsh and riparian forest habitats also are important both locally and regionally because these habitats have been substantially reduced throughout California (U.S. Fish and Wildlife Service 1991).

Open water of the river and ponds provides resting and foraging areas for water birds, including waterfowl. Unvegetated shoreline and gravel bars adjacent to the river channel also provide foraging areas for waterfowl, wading birds, and shorebirds. Aquatic mammals, including beaver, mink, and river otter, also use open water and adjacent riparian habitats as foraging areas and travel corridors (U.S. Fish and Wildlife Service 1991, U.S. Army Corps of Engineers 1996). Freshwater marsh is associated with ponds and backwaters, providing resting and foraging areas for water birds, shorebirds, and wading birds (U.S. Army Corps of Engineers 1996). Marshes are also used by aquatic mammals and provide foraging and breeding habitat for several species of aquatic reptiles and amphibians, including common garter snakes, Pacific treefrogs, and bullfrogs (U.S. Fish and Wildlife Service 1991, U.S. Army Corps of Engineers 1996).

Several species of raptors and great blue herons build their nests in the crowns of cottonwoods and other large trees along the lower Sacramento River system. A recent survey of the Woodlake site during winter on the Lower American River identified 30 individual raptors representing 6-8 unique species. Natural cavities and woodpecker holes provide nesting sites for some species, including wood ducks and common mergansers. Riparian scrub species support large numbers of insects and attract passerine birds, including several species of warblers and hummingbirds. Mammals associated with these riparian habitats include ringtails, spotted and striped skunks, raccoons, and mule deer (U.S. Army Corps of Engineers 1996). Mountain lions are occasional visitors to the Lower American River corridor.

Recreation

One of the primary purposes of the American River Parkway is to provide recreation and open space resources for the residents of Sacramento County and surrounding areas. A wide variety of recreation and open space resources exist in the Parkway, including the 26-mile-long, paved Jedediah Smith Memorial Trail; a parallel unpaved equestrian trail; boat ramps and car-top boat launch areas; developed parks and picnic sites; golf courses; interpretive centers; restrooms; access roads; nature study areas; and protected habitat areas.

The Lower American River is the central focus of the Parkway and is the most heavily used recreation river in California. It was included in the Federal and State Wild and Scenic Rivers systems because of some or all of its fisheries, wildlife, scenic, and recreational values–primarily because of its recreation and anadromous fishery values.

Of the sites proposed for restoration, Bushy Lake and Arden Bar are most accessible to the public and feature more developed recreational facilities. The Jedediah Smith Memorial Bicycle Trail and the adjacent equestrian trail both traverse all four restoration sites.

2.2.3 Other Planning Efforts

Several key local, state, and federal legislation and planning efforts relevant to the Lower American River could affect or influence this aquatic habitat restoration plan. Key planning efforts include the American River Watershed Investigation Feasibility Report, American River Long-Term Watershed Investigation, River Corridor Management Plan (RCMP) for the Lower American River, Floodway Management Plan (FMP) for the Lower American River, the American River Parkway Plan (ARPP), Lower American River Task Force, and Cal Expo Master Plan. These plans, planning efforts, and legislation are summarized below.

Floodway Management Plan for the Lower American River

The FMP is a collaborative effort spearheaded by the SAFCA to solve the physical problems of the Lower American River flood control system. The FMP balances the needs of a flood control system with the needs of other competing resources, including fishery and aquatic habitats, terrestrial habitats, and recreation and open space resources. The ultimate concern of the FMP is maintaining an acceptable level of flood protection in the Sacramento metropolitan area. In addition, the FMP addresses the following:

- aquatic and terrestrial habitat management and restoration as they relate directly to floodway management;
- recreation availability, open space protection and enhancement, and reduced impacts of floodflows on these community resources; and
- fire management consistent with meeting other resource needs.

American River Parkway Plan

The first ARPP was produced in 1962. It was revised in 1968 and 1976 with significant public input. The current version was published in 1985. The ARPP calls for evaluation and revision, if necessary, every 5 years. The American River Parkway Plan is an element of both the City of Sacramento and County of Sacramento General Plans and has been adopted by the State Legislature. An effort to update the plan is beginning and likely be lead by the Sacramento County Department of Parks, Recreation, and Open Space. The goals of the Parkway plan are to:

- provide, protect, and enhance for public use a continuous open space greenbelt extending from the Sacramento River to the Sierra Nevada;

- provide appropriate access and facilities so that present and future generations can enjoy the amenities and resources of the Parkway;

- preserve and improve the natural, archeological, historical, and recreational resources of the Parkway, including an adequate flow of high-quality water, anadromous and resident fishes, migratory and resident wildlife, and diverse natural vegetation; and

- mitigate adverse effects of activities and facilities adjacent to the Parkway.

American River Watershed Investigation Feasibility Report (U.S. Army Corps of Engineers 1991)

The purpose of this report was to conduct planning-related studies that could lead to future flood protection improvement for the Sacramento area. The studies lead to the development of four different alternatives of which one was eventually selected for implementation. The principal recommendations of this plan were to build a detention facility on the North Fork American River near Auburn, California, and to improve levees and channels in the Natomas Area. No direct measures were recommended for the Lower American River between Nimbus Dam and the confluence with the Sacramento River. This report was amended in 1996.

Lower American River Task Force

The Lower American River Task Force is a collaborative forum created by SAFCA in 1994 to improve existing flood-control facilities while protecting and enhancing the LAR's environmental and recreation resources. The Task Force's current effort is developing a River Corridor Management Plan, which is intended to serve as an overarching vision, or blueprint, for the river. The RCMP promotes a cooperative approach to managing and enhancing the LAR within the framework of the 1985 ARPP. In addition, the RCMP is intended to serve as a catalyst for updating the ARPP, so that decision-makers can strengthen its resource management provisions, address important land use and recreation-related issues, and refine existing Parkway management mechanisms as necessary to give appropriate status to the cooperative relationships that have developed over the past seven years through the Task Force and the Water Forum. In the process of developing the RCMP, the stakeholder base was broadened, and technical working groups were formed to address particular elements of the plan. There are 4 working groups: recreation, bank protection, FISH, and floodway management. Each working group is working to develop the technical sections to be included in the RCMP. Much of this document will build on existing studies, including the aforementioned studies and the CDFG's Steelhead Restoration and Management Plan for the Lower American River and the U.S. Fish and Wildlife Service's Anadromous Fish Restoration Program).

City of Sacramento Recreation Planning

In addition to the recreation planning being undertaken by the Recreation Working Group as a part of the RCMP, 2 additional trails in the planning stages would tie into the American

River Parkway. The Corps and City of Sacramento, with assistance from Jones & Stokes, are preparing construction documents for the Ueda Parkway, a multiuse trail adjacent to the Natomas East Main Drainage Canal connecting the Jedediah Smith Memorial Trail to communities to the north. The City of Sacramento is also engaging in conceptual planning for the Two Rivers Trail that will run from the new Sutter's Landing Park (at the site of the old city landfill) along the south bank of the American River to the confluence with the Sacramento River.

Bushy Lake Preservation Act

This act of the California Legislature in 1976 appears in Chapter 9, Section 5830-5835, of the Public Resources Code, California Codes, and establishes a nature preserve on the state-owned California Exposition (Cal Expo) flood plain in the Bushy Lake area. The legislature noted that this block of land remained unprotected while the City and County of Sacramento had developed the American River Parkway, a 23-mile open space greenbelt in the Lower American River flood plain:

> The California Exposition flood plain contains an unprotected block of significant riparian habitat remaining in the Lower American River flood plain, and the United States Fish and Wildlife Service has determined that this riparian habitat is of vital importance and an integral part of the American River. (Section 5832 [c]).

According to the act, the California Exposition and State Fair Board of Directors shall preserve, for public day use and enjoyment, the Cal Expo flood plain in a manner consistent with the definition of a state park in accordance with the provisions of Section 5019.53 and special conditions stated in the act.

Only current, comprehensive studies are indicated here. It is likely that additional agency programs and colleges and universities are investigating individual wildlife, fish, and vegetation issues as they pertain to the Lower American River corridor.

2.3 Site-Specific Setting, Opportunities and Constraints, and Without-Project Conditions

Four different sites were selected for detailed study of restoration opportunities. Plate 1 shows these sites.

2.3.1 Urrutia Site

Land Use/Infrastructure/Utilities

The Urrutia site is a 251-acre privately owned parcel located on the wide flood plain between RM 1 and RM 2 along the north bank of the American River. The site was mined for sand and gravel in an open pit on the flood plain. The mining resource is nearly exhausted and preliminary discussion of transferring the property to Sacramento County for inclusion in the American River Parkway has begun between the Urrutia family and the county.

Downstream and west of the site is Discovery Park, owned and operated by County Parks. Upstream and east of the site is a small private parcel leased to the Boy Scouts of America for camp activities. Adjacent to the camp is a County-owned parcel. North of the site are several utility easements, the Jedediah Smith Memorial Trail (paved recreation trail), and Bannon Slough/Steelhead Creek. Recently, the canal was officially renamed as Steelhead Creek. This waterway receives urban runoff and is influenced by backwater flows in the Sacramento River.

The Urrutia family operates its mining business from a house and several outbuildings located on the western edge of the mine pit. The house is elevated 10-15 feet to limit flooding of the first floor during high stage events.

Several utilities cross the site on the north side. Pacific Gas and Electric Company (PG&E) and Sacramento Metropolitan Utility District (SMUD) hold easements and maintain utility towers and lines across the site. There are 9 utility towers on the site.

Topography, Soils, and Hydrology

Topography. Much of the Urrutia property and adjacent easements have been disturbed from mining or related human activity. The sand and gravel pit, separated from the river channel by a berm, is estimated at 25-30 feet deep. Side slopes range from 1:1 to 2:1 slope. There is a low point in the channel bank along Bannon Slough upstream that allows water during high flows to escape and flow overland south into the Urrutia pit. This flow path is evident in aerial photographs and is visible in the field. Flows have scoured the surface creating a gully from the edge of the Urrutia pit halfway to Bannon Slough. As a result of this overland flow, a narrow band of young cottonwoods and willows have established along the gully.

The riverbank bordering the Urrutia property is very steep and degraded. Approximately half of the bank has been armored with fragments of concrete dropped from the top of bank. Other sections are sparsely vegetated and moderately eroded.

Soils. Soils along the banks of the American River adjacent to the Urrutia property are fertile but are highly susceptible to erosion. The U.S. Natural Resources Conservation Service describes three primary soil types in this area: Columbia fine sandy loam (Ce), Columbia silty loam (Co), and Riverwash. The Ce soils are found on approximately two-thirds of the site nearest to the river. This is a loose, friable soil that is readily penetrated by roots and water. The bank along the Urrutia property is of this soil type and is highly eroded with an approximately 1:1 slope.

The Co soils are found on the remaining third of the site, primarily along Bannon Slough. This soil is very similar to Ce soils except that it is not as loose and is slightly less erosive. Riverwash consists of homogenous sand and gravel with some clay and a soil overlayer. Riverwash is typically found immediately adjacent to the river channel as narrow bars and benches, although these are not present on the Urrutia site.

Hydrology. As it passes the Urrutia site, the American River is a very low-gradient stream with water surface elevations controlled by flows in the Sacramento River and the tides of the Bay-Delta. Although it is a low-gradient reach, near-bank flows can be fairly erosive primarily because of the lack of any bank vegetation to slow velocities and absorb the river's energy. The easterly area, characterized by nearly vertical banks, is particularly susceptible to bank erosion because of bank scour by the river and the lack of vegetation to assist in stabilizing the banks. There is very little sediment deposition by the river in this reach other than soils that collapse or are scoured from the banks, and these are usually moved downstream during the next moderate flow. American River flows in the range of 30,000-35,000 would inundate the high flood plain. The return rate of flows of this magnitude is approximately once every 5 years.

The open water of the mining pit, Bannon Slough, and a small, isolated wetland just west of the pit characterizes surface water hydrology at the site. It appears that rainfall and overflow from Bannon Slough influence the surface water level of the pit in addition to the water surface elevation of the river. The isolated wetland is located at the easternmost end of a natural swale that extends west through the center of the flood plain and into Discovery Park.

Vegetation

The Urrutia site is dominated by ruderal grassland and compacted earth around the perimeter of the sand and gravel pit that limits the growth of vegetation. There are patches of mature Fremont cottonwood on the west end of the site adjacent to Discovery Park and the river and on the east end of the site adjacent to and throughout the Boy Scout camp. In addition, the southern bank of Bannon Slough is dominated by mature Fremont cottonwood with willow species, Mexican blue elderberry, Himalayan blackberry, white alder, and wild grape. The wild grape is particularly prolific, forming a dense, draping understory.

A seasonal wetland that is recovering from fire is located on the west end of the site adjacent to Discovery Park. This wetland appears to be converting to more mesic species, including willow and cottonwood.

The ruderal grassland areas harbor some nonnative invasive species, including yellow star-thistle, Russian thistle, and Himalayan blackberry. However, none of these species had become dominant as of fall 2000.

Fish and Wildlife

Wildlife use of the site is likely limited to the vegetated areas along the periphery. Anadromous fish, including steelhead, have been found in Bannon Slough. It is possible that some fish are flushed into the Urrutia pit during high flows either from Bannon Slough or the American River, although to date a fish stranding problem has not been documented. A fish survey of the mining pit has not been conducted to date.

Cultural Resources

The records search indicates that 10 cultural resource studies have been conducted in the proposed Urrutia restoration site. Intensive survey coverage of the proposed restoration area comprised a total of 115 acres and approximately 1.5 linear miles. (Cultural Resources Unlimited 1993; Dondero 1978; Lindström 1990; Nilsson et al. 1994, 1995; O'Connor and Wiant 1982; Ann S. Peak & Associates 1974, 1975, 1978). Ann S. Peak & Associates (1973) conducted a reconnaissance-level survey of the Urrutia restoration site. Eight previously recorded cultural resources are located within the boundaries of the Urrutia restoration site (Heizer 1934; Lindstrom 1990; Nilsson et al. 1995; Ann S. Peak & Associates 1973, 1975, 1978). Additionally, a local bridge has been evaluated at the crossing of Northgate Boulevard and Steelhead Creek (NEMDC) and was recommended ineligible for listing in the National Register of Historic Places (NRHP) listing (Bridge # 24C0099).

Nine cultural resource studies have been conducted adjacent to or within a ¼-mile radius of the Urrutia restoration site (Boghosian 1993a, 1993b; Derr 1990; 1993a, 1993b; Dondero 1978; McIvers 1987; Nelson et al. 2000; Ann S. Peak & Associates 1979). A historic bridge is located within a quarter-mile of the project site and has been recommended for NRHP listing (Bridge # 24-0001 L&R). There is also an unrecorded portion of the Sacramento Northern Railroad at the southeastern boundary of the proposed restoration site.

Potential Cultural Resources. Seven potential cultural resources are located in the Urrutia restoration site. These potential resources comprise three structures, two light-duty roads, and a racetrack, all of which are in the vicinity of Camp Pollock, and Bannon Slough. These historic features date between 1949 and 1954 (U.S. Geological Survey 1954a, 1954b), but only one road segment is discernible from modern aerial photographs of the area. These seven potential cultural resources were identified using historic topographic maps and aerial photographs and would need to be verified by a field survey.

Recommendations. Approximately 115 acres of this restoration area have been surveyed intensively for cultural resources. The rest of the Urrutia restoration site was surveyed more than 10 years ago or at a reconnaissance level or both. To comply with Section 106 of the National Historic Preservation Act (NHPA) and professional archaeological protocol, approximately 285 acres of the Urrutia restoration area would have to be inventoried for cultural resources.

Five of 9 cultural resources located in the Urrutia restoration site would require NRHP evaluations. These cultural resources include a prehistoric site (CA-SAC-31), 2 historic roads (CRU-93-SAC-24H and CRU-93-SAC-25H), the northern American River levee (CA-SAC-481H), and a historic site that possibly was a prehistoric component (CA-SAC-306/H). Evaluation of CA-SAC-31 would require test excavation of the site to determine the extent of undisturbed cultural deposit and/or consultation of existing collections and reports of excavation from CA-SAC-31. Test excavation and historical research would be required to evaluate the significance of CA-SAC-306/H. CRU-93-SAC-24H, CRU-93-SAC-25H, and CA-SAC-481H would be evaluated through the development of appropriate historic contexts. Subsequently, an

assessment of project effects on any significant cultural resources (i.e., resources eligible for listing) would need to be conducted and appropriate mitigation measures developed.

Of the 9 known cultural resources in the Urrutia restoration site, only the Steelhead Creek (NEMDC) levee (CA-SAC-463H) has been recommended eligible for NRHP listing, as a contributor to the Reclamation District 1000 rural historic landscape (Bradley and Corbett 1995). Effects on CA-SAC-463H resulting from the proposed restoration project would have to be assessed and, if appropriate, suitable mitigation measures established.

Without-Project Conditions

The Urrutia site has been severely degraded as a result of past upstream land uses and the present extraction of sand and gravel. Without taking active measures to restore the compacted barren ground, reestablish riparian habitat, and reintroduce native plant communities, it is likely that present problems at the site will persist. The riverbank will continue to erode until the few remnants of streamside vegetation and overbank canopy are lost. The absence of additional flood plain vegetation will facilitate future bank erosion and will preclude shaded aquatic habitat for native fish species either in the form of overhead cover or instream woody material and may create an opportunity for nonnative invasive species to establish. Although cottonwoods probably would continue to regenerate along the gully even with no action at this site, the steep banks of the pit will prohibit most native riparian species from establishing. The open water will continue to provide some habitat for waterfowl, but it will also likely continue to trap native anadromous fish species during overbank riverflows. If the barren ground now on the site is allowed to naturally colonize, it is likely to become infested with yellow star-thistle and nonnative ruderal vegetation that can readily adapt to disturbed soils.

Plate 2 summarizes the without-project conditions of the Urrutia site.

Summary of Opportunities and Constraints

The following constraints should be considered when selecting a restoration strategy for the Urrutia site:

- The existing sand and gravel mine pit is large. Filling portions of the pit and recontouring its banks to provide desirable habitat would require a large amount of earthwork.
- The property would have to be acquired by a local jurisdiction.
- Existing utility easements restrict the height of vegetation in the easement.
- Vehicular access must be maintained to each utility tower.
- The bicycle trail may need to be rerouted to accommodate restoration activities.

- Known and potential cultural resources will need to be integrated into any detailed restoration planning effort for this site.

The existing site conditions provide the following opportunities for developing a restoration strategy for the Urrutia site:

- Expand existing riparian habitats along Bannon Slough and Discovery Park into the site with moderate earthwork to establish the appropriate hydrology.

- Reshape sand and gravel pit to accommodate wetland and riparian habitat along perimeter.

- Terrace the north riverbank to provide suitable hydrology for cottonwood riparian regeneration.

- Convert use of the site from industrial to habitat and/or passive recreation.

Plate 3 summarizes the problems and opportunities associated with the Urrutia site.

2.3.2 Woodlake Site

Land Use/Infrastructure/Utilities

The 283-acre Woodlake site is a predominantly wild land site on the north bank of the American River between RM 2 and RM 4. The large central area was cultivated for hay up until 1998. Portions of the site have been used as borrow sites for fill to construct and/or repair adjacent railroad beds and flood control levees. A small area in the northeastern corner of the site has been used for valley elderberry longhorn beetle (VELB) mitigation.

The Woodlake site is bordered by the American River to the south, raised railroad beds to the east and west (Southern Pacific and Union Pacific Railroads, respectively), and Sacramento River project levee to the north. Inside of the levee are the Jedediah Smith Memorial Trail and a naturalized drainage channel. The drainage channel receives urban stormwater runoff from Sump Pump No. 151, operated by the City of Sacramento. The urban watershed includes residential, commercial, and light industrial land uses.

Several utility corridors cross the site from east to west. A total of 42 steel towers and wood poles are located at the site. These overhead utilities are owned or operated by SMUD, PG&E, and Western Area Power Authority (Western). In addition, 3 radio station transmission towers (KXOA) and an associated control building are located in the center of the site. This area is fenced off by 6-foot chain-link fence with razor wire. Dirt access roads are located around the perimeter of the site, to the radio towers, and to the utility towers.

The Jedediah Smith Memorial Trail is located on the northern boundary of the site, and the horse trail generally follows the river along the top of an earth berm.

Topography, Soils, and Hydrology

Topography. The site is generally flat, although two areas (8.5 acres total) adjacent to the river have been excavated for fill dirt for nearby railroad and flood control infrastructure. These borrow sites are slowly developing riparian habitat along their periphery but are disconnected from the river channel by a narrow, steep berm. A large, seasonal wetland is situated in the center of the flood plain with a low point approximately 10 feet below the ridge elevation adjacent to the river. A linear borrow channel along the north portion of the site immediately adjacent to the levee carries water around the perimeter of the flood plain before it enters the American River.

Soils. The Woodlake area soils include Columbia sandy loam, drained, and Laugenour loam, partially drained. Soil test pits were excavated as part of the Discovery Park East and Woodlake Area Plan (EIP 1996). The test pits were approximately 17 feet deep and did not reveal the presence of any aggregate material. A generalized soil profile for the Woodlake area is as follows:

Depth	Description
0-3 feet	Silty sand
3-12 feet	Sandy silt to clayey silt with clay content increasing with depth
12-15 feet	Silty clay to clayey silt with clay content increasing with depth
15+ feet	Moderately cemented hardpan composed of sandy silt; cementation decreases with depth

Hydrology. The flood plain at Woodlake would be inundated by American River flows in the range of 30,000-35,000 cfs. The average frequency of flows of this magnitude is approximately once every 2.5 years. Water surface elevations at the site are controlled by the stage of the Sacramento River, which fluctuates daily with tides. Flow velocities in this reach are relatively slow, even during floods. Motorized boat traffic is frequent in this reach. Bank erosion is attributable to tidal and reservoir-release changes in water surface elevation, boat wake, and, probably to a lesser degree, floodflow. As the river flows by the Woodlake site, it deposits very little sediment. Sediment normally would create beaches and point bars in lower reaches of this alluvial river, resulting in a transition between higher flood plain surfaces and the river channel. However, in this reach of the river, the banks are unnaturally tall and steep between the river channel and the flood plain, primarily as a result of accretion of the flood plain during the hydraulic mining era followed by incision (downcutting) of the channel, and absence of sediment from upstream sources because of the presence of upstream dams. A modest strip of riparian forest along the edge of the north bank helps to stabilize the north bank.

Surface water hydrology is characterized by the presence of seasonal wetlands and a borrow channel. Two isolated seasonal wetlands created by borrow pits described above capture overbank flows and rainfall. A 2.6-acre linear seasonal wetland drains north but may also

occasionally fill up from flows overtopping the borrow channel. The borrow channel flows east at a low-gradient along the base of the levee before turning south and flowing along the Southern Pacific Railroad tracks before emptying into the American River via a culvert. The culvert outlet is approximately 20-25 feet above the active river channel. The supply of water for this ditch is pumped from Sump Pump No. 151 through the levee. Where the channel flows south, the gradient is much steeper and the channel much narrower, creating an incised condition and unstable banks.

Vegetation

Approximately one-third of the Woodlake site is vegetated by woody plant communities. Areas along the drainage channel and the American River are dominated by mature Fremont cottonwood and mixed riparian species. A portion of the high flood plain is dominated by relatively new recruitment of valley oak, California black walnut, and Mexican blue elderberry. The remaining two-thirds of the site is dominated by ruderal grassland with an 8.5-acre seasonal wetland northwest of the radio transmission towers. The borrow channel supports areas of permanent wetland dominated by cattail.

An area in the northwestern corner of the site was excavated approximately 2-5 feet, presumably as borrow for another project. This area was then planted and/or revegetated naturally with a diverse array of riparian species. The trees and shrubs in this area are flourishing presumably because of seasonal flooding from the adjacent borrow channel and the lowering of the flood plain nearer to the groundwater table.

A mitigation site for VELB is located in the northeastern corner of the site. This mitigation was constructed for VELB impacts associated with commercial construction outside of the flood control levee, just north of the site. The Mexican blue elderberry shrubs planted as mitigation are not thriving; however, the reason has not been identified.

The ruderal grassland was cultivated for hay production up until 1998, when the farming lease ended. Subsequently, this area has been invaded by yellow star-thistle along with an array of nonnative annual grasses. Yellow star-thistle (*Centaurea solstitialis*), a native of Eurasia, was first recorded in California in 1869. It is now estimated to infest more than 8 million acres in California. This rapid colonizer favors disturbed areas, such as abandoned farm fields, roadsides, and former grazing lands. It forms dense infestations and may produce allelopathic chemicals that slow the growth of competing species, allowing star-thistle to take over large areas of land and suppressing the establishment of native plant species. Yellow star-thistle is unfortunately common in the Lower American River, especially in areas like Woodlake that were formerly cultivated (Lanini n.d.).

There are several large patches of other nonnative invasive plants throughout the mixed riparian vegetation. Species of particular concern include giant reed (*Arundo donax*), black locust (*Robinia pseudoacacia*), and scarlet wisteria (*Sesbania punicea*). Giant reed is a large perennial grass. It can grow up to 25 feet tall and forms a dense clump of hundreds of stems. The plant spreads vegetatively and is generally found along stream courses. It invades riparian

areas and effectively chokes out more desirable native species. In addition, giant reed consumes three times more water than native plants, is a fire hazard, and can create flood control problems. (Hoshovsky 2000.)

Black locust aggressively invades dry flood plains where it shades or outcompetes desirable sycamore and oak woodland/savanna species. This plant grows and propagates vigorously in full sun and reproduces by rapid vegetative growth and colonial spread. The vigor of suckers and root sprouts is increased following top removal by fire or cutting. (Converse 2000.)

Scarlet wisteria is a deciduous shrub or small tree with bright red flowers in spring and winged seedpods that are easily dispersed by water. This plant is new to the American River; it was first identified in the corridor around 1995. This South American plant is a serious weed in southern Africa, Florida, Texas, and Georgia. It grows in moist areas, usually along rivers and streams, typically occupied by willow species. Scarlet wisteria threatens to outcompete willow species on newly formed banks and bars. (The Nature Conservancy 2000.) A few scarlet wisteria plants were found on sandbars along the river at the Woodlake site. Although this plant is not a serious problem at this site yet, the open sandbars and beaches along the river are ripe for invasion by this species.

Fish and Wildlife

The existing vegetation provides relatively good habitat, including forage, cover, permanent water, and roost sites for wildlife, especially avian species. The expanse of ruderal grassland provides forage habitat for many raptor species. A recent winter survey documented 20-30 individual raptors representing 6-8 different species during the wintering months. The existing seasonal wetland, drainage channel, and borrow pits are known or potential fish stranding sites when high flows recede during the months of December through March. The drainage channel may also harbor warm water and predatory fish, although it also provides substantial wetland and riparian habitat.

Cultural Resources

A records search indicated that 8 cultural resources studies have been conducted in the proposed Woodlake restoration site. Survey coverage comprised a total of 240 acres and approximately 2.5 linear miles of the proposed restoration site (Cultural Resources Unlimited 1993; Dondero 1978; Nelson et al. 2000; Nilsson et al. 1994, 1995; Ann S. Peak & Associates 1973, 1974, 1978). Four previously recorded resources are located within the boundaries of the Woodlake restoration site: CA-SAC-464H, CA-SAC-478H, CA-SAC-481H and CA-SAC-39. CA-SAC-39 is listed in the NRHP (Pritchard 1970). CA-SAC-478H includes a segment of the First Transcontinental Railroad as well as a railroad bridge. This cultural resource was recommended eligible for listing in the NRHP and California Register of Historical Resources (CRHR) (Jones & Stokes Associates 1999b).

Eight cultural resources studies have been conducted adjacent to or within a ¼-mile radius of the Woodlake restoration site (Holman 1996; Jones & Stokes Associates 1999a, 1999b; Nilsson et al. 1995; Offermann and Noble 1995; Ann S. Peak & Associates 1989; Theodoratus Cultural Research Inc. 1987; Windmiller 1997).

Potential Cultural Resources. Four potential cultural resources are located in the Woodlake restoration site, comprising two structures at opposite ends of an unimproved road and Bannon Slough (U.S. Geological Survey 1954a, 1954b). Only a portion of the road segment is visible on modern aerial photographs, as is Bannon Slough.

Recommendations. Intensive survey coverage of the Woodlake restoration site comprises approximately 320 acres (Bradley and Corbett 1995, Cultural Resources Unlimited 1993, Nilsson et al. 1995, Windmiller 1997). The remaining coverage of the restoration site was conducted more than 10 years ago (Ann S. Peak & Associates 1973, 1974). To comply with Section 106 of the NHPA and professional archaeological protocol, approximately 80 acres of the proposed Woodlake restoration site would need to be surveyed for cultural resources.

Three of 4 identified cultural resources located in this restoration site would require NRHP evaluations. Two cultural resources are historic railroads and would be evaluated through historical research. The NEMDC (CA-SAC-481H) would also require historical research to be evaluated for NRHP eligibility. If any of these cultural resources are recommended eligible for NRHP listing, project effects on the resources would have to be assessed and, if appropriate, suitable mitigation measure established.

CA-SAC-39, the Woodlake site, is a prehistoric mound that is listed in the NRHP. It is also listed in the California Inventory of Historic Places (California Department of Parks and Recreation 1976) and the California History Plan. Project effects on CA-SAC-39 would have to be assessed and appropriate mitigation measures developed to allay significant effects on this cultural resource.

Without-Project Conditions

Since the termination of the haying of the Woodlake site, yellow star-thistle has rapidly infested the eastern edge of the site and is likely to continue to expand its range, reducing the capability for native plants and grasses to establish on the flood plain. The ditch adjacent to the Southern Pacific Railroad tracks supports a very thin band of riparian forest; however, as it continues to incise, the banks are likely to fail, causing trees and shrubs to collapse into the channel. If present conditions persist, it is likely that considerably more of the site will give way to patches of nonnative trees and grasses that will take advantage of the absence of frequent overbank germination flows and a shallow water table suitable for supporting native riparian species and disturbed soils.

The Woodlake site has been identified by SAFCA as a potentially suitable site to initiate a Sacramento splittail restoration project. This project might entail excavation of a side channel into the flood plain that would include the current 8.5-acre seasonal wetland. In total, it is

estimated that approximately 32 acres between the river channel to a point just beyond the eastern point of the seasonal wetland would be involved in this restoration project. The proposed habitats associated with this project include shallow aquatic, seasonal wetland, and riparian forest. This project would provide benefits to other wildlife and fish species as well.

Plate 4 summarizes the without-project conditions of the Woodlake site.

Summary of Opportunities and Constraints

The following constraints should be considered when selecting a restoration strategy for the Woodlake site:

- Agreements in the county deed for the site stipulate that the site could be used as VELB mitigation for the previous landowner.

- In portions of the site, the elevation of the present flood plain is substantially higher than the natural flood plain. This will restrict or limit the amount of riparian habitat restoration that can be achieved without significant excavation in the eastern portion of the site.

- Disturbance of existing high-quality habitats should be avoided to the greatest extent possible while achieving the restoration goals and objectives.

- Existing utility easements restrict the height of vegetation in the easement.

- Earthwork cannot adversely affect utility and radio towers. Vehicular access must be maintained to each utility tower and the radio towers.

- The horse trail may need to be rerouted to accommodate restoration activities.

- Known and potential cultural resources would need to be integrated into restoration planning efforts for this site.

The existing site conditions provide the following opportunities for developing a restoration strategy for the Woodlake site.

- Breaching the artificial berms separating the river channel from the two seasonally inundated depressions in the mixed riparian forest at the downstream end of the site would assist in restoring a natural overflow regime in these areas, allowing them to support more wetland and riparian vegetation and creating shallowly flooded aquatic habitat needed by splittail for spawning. Permanent lentic aquatic habitat connected to the river channel also could be created. Because of relative low elevations of the depressions, required earthwork volumes would potentially be manageable, compared to higher elevations that characterize the eastern portion of the site.

- The former hayfield is an ideal location for introducing large native grassland and oak savanna habitats, two habitats that have decreased rapidly in the region.

- Expanding the riparian forest along the entire borrow channel would increase food, shelter, and cover for species using this as a wildlife corridor.

- Reshaping the north-south portion of the borrow channel adjacent to the railroad to include a longer channel length and shallower slopes would create the right conditions to plant more native riparian plant species along this corridor and increase the residence time of the urban water on the flood plain for filtration and infiltration purposes.

- Controlling nonnative invasive species on the site, especially yellow star-thistle would allow native grass and plant species to thrive absent competition. It would also increase the wildlife value of the habitats on the flood plain.

Plate 5 summarizes the problems and opportunities associated with the Woodlake site.

2.3.3 Bushy Lake Site

Land Use/Infrastructure/Utilities

The 347-acre Bushy Lake site is a predominantly wild land site between RM 4 to RM 5.5 on the north bank of the river. The central feature of the site is Bushy Lake, a shallow open water body that developed from a borrow site. City Sump Pump No. 152, overland flood flows, and groundwater pumped from Cal Expo are the sources for the water in the lake.

Capital City Freeway borders the site to the west, and a Sacramento County pumping facility for Chicken Ranch and Strong Ranch Sloughs borders it to the east. The north boundary is a Sacramento River project flood control levee. Beyond the levee to the north is Cal Expo.

The site is crossed by numerous overhead utilities and underground cables spanning east to west through the center of the site. PG&E, SMUD, and the Central Valley Project (CVP) all have easements for maintenance of their utility corridors. In addition, there are telephone poles at the base of the levee. Together, these utilities constitute an easement approximately 280 feet wide. The SMUD easement connects to the CVP and PG&E easement in the northeastern corner of the property.

Topography, Soils, and Hydrology

Topography. The site topography has been disturbed by past human activities, including excavation of borrow material for levee maintenance and partial grading for a golf course in the 1980s that was never completed. The golf course grading included creation of several earth mounds and excavation of the southern arms of Bushy Lake. Based on aerial photography, Bushy Lake covers approximately 12 acres, not including shallow arms flanking the southern

bank of the pond. The average water depth is approximately 18 inches; therefore, the volume of Bushy Lake is approximately 18 acre-feet.

Soils. The Bushy Lake area soils include Columbia sandy loam - drained, Rossmoor fine sandy loam, Riverwash, and Xerofluvents. Columbia sandy loam is generally found on low flood plain areas typical of a large area directly south of Bushy Lake. Rossmoor soils are common to high flood plains typical of the west half of the site. Riverwash consists of unstabilized sediments frequently reworked by the river. The sparsely vegetated sand and gravel bar nearest to the river is primarily Riverwash. Xerofluvents are also found on low flood plains as well as high flood plains dissected by side channels. Xerofluvents typically support riparian and wetland vegetation. The west end of the site and the hummocky ground on either side of the Riverwash is this soil type.

Geocon Consultants conducted percolation tests in October 2000. Four exploratory trenches (10-12 feet deep) and 12 percolation trenches (1½ to 6 feet deep) were excavated with a backhoe. Percolation holes in the trenches were 2½ to 7½ feet deep. Results showed the soils are generally very permeable and seven of the 12 trenches were free draining.

Hydrology. The Bushy Lake site consists of two drainage basins. The northern two-thirds of the site drains into Bushy Lake and the urban stormwater runoff channel at the toe of the levee. This stormwater channel enters the site via Sump Pump No. 152 at the northwestern corner of the site. This water flows west and south out to the American River via a culvert beneath Capital City Freeway; however, it also flows east toward Bushy Lake. Sediment deposition, a beaver dam, and a channel-crossing metal fence with thick vegetation and woody debris block flows from reaching Bushy Lake, except during peak stormwater flows. The southern portion of the site drains into the American River via overland flow. Chicken Ranch and Strong Ranch Sloughs are pumped through the levee at the eastern edge of the site and directly enter the American River via a concrete-lined channel. There are a low-flow outlet and a high-flow, or floodflow, outlet for these drainages.

The Bushy Lake site has the last low-flow point bar on the river before it enters into the backwater pool of the Sacramento River. The site is also the upper limit to tidal influences. At flows above 30,000 cfs, most of the Bushy lake site would be inundated with overbank flows.

Water Supply and Water Quality

Water Supply. Bushy Lake is an isolated pond located on the northern bank of the Lower American River adjacent the Cal Expo fairground. Its primary source of water during the summer months is local groundwater pumped from a well on Cal Expo's property. Peak pumping reaches approximately 80,000 gallons per day during the summer months, as reported by Cal Expo staff. During the wet season, Bushy Lake receives water from a small, localized watershed; from the channel leading from Sump Pump No. 152, and from the American River during flood events. Water released to the flood plain from this sump pump flows east in the direction of Bushy Lake. Such a hydrologic connection suggests that Bushy Lake receives urban runoff during the wet season.

While historically the Bushy Lake area was marshy, the current characteristics of Bushy Lake are primarily the result of its expansion and excavation for borrow material and the proposed golf course development. An artificial channel leads to the west, past Sump Pump No. 152, through a small, concrete culvert underneath Capital City Freeway, and eventually drains into the American River. This waterway also supplies water to West Bushy Lake, a small water body just off of the channel located between Capital City Freeway and the railroad tracks. A small weir, located just beyond West Bushy Lake, helps maintain its water levels. During peak storm events, this weir is overtopped and water flows directly into the river.

Water Quality. On December 20, 2000, Jones & Stokes staff members collected field measurements for depth, dissolved oxygen, and temperature, as well as grab samples for physical and aggregate properties, organic, inorganic and microbiological constituents. Sampling was conducted to provide background information regarding Bushy Lake water quality related to possible future restoration efforts. It should be noted that this sample is only a snapshot of the water quality for this particular time, and does not reflect any trends, patterns, or seasonality of loading of particular elements in Bushy Lake.

Before sampling, an effort was made to identify existing sources of water quality data. Sacramento County has collected extensive data on Strong Ranch Slough, including wet and dry weather water quality. Data could not be located for Bushy Lake, prompting the need to collect baseline surface water quality. The following summarizes field and analytical results. A description of field and analytical methods employed in baseline data collection can be found in the tables 1 and 2.

Duck weed covers approximately 80 percent of Bushy Lake's open water surface. A continuous crop of aquatic vegetation that extends throughout the water column bisects Bushy Lake at its midpoint. Sulfidic odors were detected from bottom sediments suspended during the transport of the canoe. Because Bushy Lake is a repository for flows and does not permit flow-through, it acts as more of a farm pond than a high-quality freshwater wetland.

Mean depth of the six measuring points was 18 inches (not a weighted surface area mean depth). Maximum observed depth was 25 inches. Depth visually appeared uniform between sampling points, with no major change. It should be noted, however, that depth measurements included an approximately 4- to 6-inch detritus layer, a fluidic ooze of settled materials. This layer was easily suspended upon disturbance from a paddle blade or frightened duck.

The results of the water quality analyses conducted by CLS Laboratories in Rancho Cordova, California, revealed constituents typical of urbanized streams. Nondissolved metals included lead and mercury; dissolved metals included copper and zinc. Dissolved oxygen was low. High levels of the nutrients ammonia and phosphorus were present. Table 1 lists the water quality constituents tested. The results of the analysis are shown in table 2.

Extended research into the water quality of Bushy Lake was conducted in November 2001 by Jones & Stokes and is included in the attached Technical Study, specifically in Chapters 1, 2, 4, and 9.

Vegetation

The Bushy Lake site supports five habitat types: riparian scrub, riparian forest, elderberry savanna, grassland, and permanent marsh. The area surrounding Bushy Lake, including the southern arms of the lake, is predominantly riparian scrub. The steep perimeter of the lake retains very little cottonwood canopy. The interior of the fingers of the lake have small, elevated stands of willows, whereas the remainder of the bed is covered with cocklebur. The area south of the lake was once dominated by Fremont cottonwood; however, most of these trees were destroyed by fire. Riparian scrub is also the dominant habitat type nearest to the river. Cottonwood forest is establishing in some of these lower areas. Several large stands of willow occupy the sand and gravel bars where high-velocity floodflows frequently reshape the flood plain.

Elderberry savanna dominates several areas, including a large population adjacent to Capital City Freeway and another at the eastern end of the site. Other species in this community include valley oak, ash, coyote bush, and several nonnative tree species. Annual grassland and herbaceous nonnative species cover large portions of the site. There are several pockets of nonnative tree species, including acacia, Chinese tallow tree, giant reed, and a grouping of pine trees near the Cal Expo overflow parking area east of Bushy Lake.

Fish and Wildlife

Numerous species of birds were observed during field reconnaissance surveys in fall and winter 2000, including great blue heron, white egret, and belted kingfisher. Small larval-sized fish, presumed mosquitofish, were observed near the bisecting crop of floating aquatic vegetation. Overwintering mosquitoes were seen to take flight from aquatic vegetation when disturbed. A single deer was observed by field staff, as was a large beaver lodge. However, there was no recent evidence of beaver activity around Bushy Lake.

It is likely that during overbank flows, Bushy Lake strands fish on the flood plain with no outlet to the American River.

Cultural Resources

The records search indicated that four cultural resources studies have been conducted in the proposed Bushy Lake restoration site (Ann S. Peak & Associates 1973, 1974, 1980; Dondero 1978). Survey coverage comprised a total of 309 acres and approximately 1.5 linear miles of the proposed restoration site. The only previously recorded site, CA-SAC-481H, is located along the periphery of the proposed Bushy Lake restoration site. There have been seven cultural resources studies conducted within the ¼-mile boundary of the proposed restoration site (Harper 1974;

Jones & Stokes Associates 1999a, 1999b; Nilsson et al. 1995; Offermann and Noble 1995; Maniery 1995; Theodoratus Cultural Research 1987).

Potential Cultural Resources. A historic topographic map of the proposed restoration site indicates that an unimproved road may be present (U.S. Geological Survey 1954a, 1954b). The road segment, which dates to approximately 1949-1951, is visible on modern aerial photographs of the Bushy Lake restoration site.

Recommendations. Previous cultural resources surveys covered the entire Bushy Lake restoration site (Dondero 1978; Nilsson et al. 1995; Ann S. Peak & Associates 1973, 1974, 1980). Except for the Nilsson et al. (1995) survey along the north levee, previous surveys of the restoration site were conducted more than 10 years ago. To comply with Section 106 and professional protocol, the proposed Bushy Lake restoration area needs to be resurveyed, except for the north levee.

One previously recorded cultural resource is located in the Bushy Lake site. This historic levee would have to be evaluated for NRHP eligibility through historical research. If CA-SAC-481H is recommended eligible for NRHP listing, an assessment of project effects on the levee would be conducted and appropriate mitigation measures developed.

Without-Project Conditions

The Bushy Lake site is in a state of ecological decline that threatens its integrity. Should no active ecological restoration projects move forth for this site, it is likely that the qualities that originally spurred the California Legislature to pass the Bushy Lake Preservation Act in 1976 will be lost. The site is host to a healthy number of elderberry bushes that, without disturbance, will continue to play the important role of host to the endangered VELB. However, much of the rest of the site is threatened by rapid infestations of nonnative plant species, including yellow star-thistle, black locust, giant reed, Himalayan blackberry, and sweet fennel.

The artificially sustained Bushy Lake itself is probably in the most danger of rapid decline. The trends at the site that will continue without intervention are the loss of the cottonwood canopy around the perimeter of the lake, eutrophication of the water body, and the fingers of Bushy Lake will remain dominated by cocklebur. There is no guarantee that the lake will continue to be sustained by groundwater pumped from Cal Expo's well, and its only other consistent source of water is the channel leading from Sump Pump No. 152. However, this channel provides water to the lake only during large storm events when the pump is operating. Even when water is being discharged from the pump in summer, the streambed gradient does not provide for positive drainage all the way into the lake.

The Bushy Lake site, also referred to as the Cal Expo flood plain, is not presently owned by an entity that is charged with managing the site for wildlife habitat values, water quality, or ecological integrity. Unless the management of the site is transferred to a different entity, or Cal Expo has an incentive to manage it for these values, the site is likely to remain in a state of ecological decline.

Plate 6 summarizes the without-project conditions of the Bushy Lake site.

Summary of Opportunities and Constraints

The following constraints should be considered when selecting a restoration strategy for the Bushy Lake site:

- Overflow parking for Cal Expo needs to be maintained.
- Water quantity and quality in Bushy Lake should be improved if possible.
- Disturbance of existing high-quality habitats should be avoided to the greatest extent possible while achieving the restoration goals and objectives, in particular VELB habitat.
- Existing utility easements restrict the height of vegetation in the easement.
- Most of the flood plain at this site has a relatively high elevation above the river, requiring that considerable earthwork would be necessary in most areas to develop prime cottonwood riparian, wetland, or aquatic habitat.
- Vehicular access to each utility tower and the radio towers must be maintained.
- The horse trail and bicycle trail may need to be rerouted.
- Known and potential cultural resources would need to be integrated into restoration planning efforts for this site.

According to the Floodway Management Plan, Bushy Lake is not reaching its full biological potential. Unnatural fires have destroyed many acres of riparian habitat, and water quality in the lake decreases in summer with lowering lake levels and warmer temperatures, despite the contribution from groundwater pumping. The following opportunities could be developed into a restoration strategy for the Bushy Lake site:

- Expand existing riparian habitats along the drainage channel between Sump Pump No. 152 and Bushy Lake with moderate earthwork to create a hydrologic system that would support riparian and wetland species.
- Reshape the bed and banks of Bushy Lake to create an open water area that responds more naturally to reintroduced hydrological processes.
- Establish new or expand existing flood plain habitats, including valley oak-sycamore woodland and savanna, California black walnut, and Mexican blue elderberry associations.

- Reduce or eliminate potential anadromous fish stranding sites by providing positive drainage to the American River.

- Provide additional anadromous fish habitat in the form of shallowly inundated seasonal aquatic habitat by connecting existing isolated backwater areas to the river

- Control or eliminate nonnative invasive species found on the site, including giant reed and Chinese tallow tree, and replace them with more desirable and productive native species.

- Terrace the north riverbank to provide suitable hydrology for cottonwood riparian regeneration if a hydraulic study proves this to be feasible given the shear stress at this site during flood stage.

- Direct urban runoff from Chicken Ranch and Strong Ranch Sloughs through a storage wetland to improve the quality of the water before it enters Bushy Lake and the American River. Plant tules in the storage wetland for uptake of contaminants from urban runoff and harvest vegetation on a regular basis to prevent high levels of bioaccumulation.

- Create outlets from the fingers of Bushy Lake to discharge water, and provide a fish escape route toward the Lower American River when the lake fills to capacity during a large storm or flood event

Plate 7 summarizes the problems and opportunities associated with the Bushy Lake site.

2.3.4 Arden Bar Site

Land Use/Infrastructure/Utilities

The Arden Bar site is a 280-acre site located approximately between RM 12 and RM 13. Its current uses include approximately 45 acres of developed parkland, a 33-acre former sewage treatment plant presently used as a training facility by the Sacramento County Sheriff's Department, a 34-acre stocked (by California Department of Fish and Game) fishing pond, and a mix of formal and informal trails. A line of telephone utility poles transects the site north-south along the eastern edge of Arden Pond. A maintenance road runs adjacent to the poles.

The park, William J. Pond Recreation Area, consists of two parking lots, turf, and picnic facilities primarily used for passive recreation, and access to the fishing at Arden Pond and occasionally as a launch location for kayakers. The County of Sacramento manages the developed park portion of the site. The Jedediah Smith Memorial Trail traverses the site between the levee enclosing the sheriff's training facility and Arden Pond and exits at the north end of the site, where it crosses the river (the bicycle bridge) to the south bank. At the south end of the site is Harrington Access, a boat ramp frequently used as the terminus for rafting trips on

the Lower American River. A wooden bridge allows the trail to cross the channel draining into the north end of Arden Pond. Immediately to the west of this outlet is a fishing platform.

The sheriff's training facility is located behind a levee that was constructed to protect the sewage treatment plant. The plant is no longer operational, and the Sheriff's Department is planning on relocating its training facility to the former site of McClellan Air Force Base.

Almost half of the site, primarily along the river at the northeast end of the site, consists of lightly vegetated sand and cobble bars interspersed with riffles and side channels.

Topography, Soils, and Hydrology

Topography. The creation of Arden Pond was the result of prior sand and gravel mining activities on the site. The pond appears to have a relatively uniform bottom, creating a mostly shallow pond that was no more than 48 inches deep upon visual inspection during a site visit in October 2000. An approximately 10- to 12-foot-deep, 1,300-foot-long finger of the pond creates seasonal wetland habitat. The maintenance road running along the east edge of the pond has been previously bolstered on its upstream end by rock-filled gabions. Floodflow forces of the river have buckled some of the gabions and washed cobble and sediment from the maintenance road into Arden Pond. At the south end of the site, between the pond and the river, is a high bluff separated from the river by a low-lying bench supporting a lush mixture of riparian vegetation. Much of the area to the west, and downstream, of the pond is cobble dredge-tailing piles. The north and west banks of the pond are quite steep with approximately 1:1 slopes.

Soils. Soils on the site primarily consist of two types, Xerofluvents and Rossmoor. Xerofluvents are very deep, excessively drained soils that are characterized by small drainageways, or channels, that are frequently flooded during spring and winter riverflows. These are typically the soils associated with the lowest lying areas on Arden Bar, including the near-stream gravel and sand bars, the pond, and the north and south banks of the pond. The high flood plain between the pond and the river channel is likely the result of the accumulation of fine earth sediments removed from the sand and gravel extraction activities that occurred on the site. The soils adjacent to the levee are primarily of the Rossmoor series that occur on higher flood plains and are less frequently inundated by riverflows, especially since the construction of the upstream dams. Most of this soil type on the site has been converted to parkland or lies underneath the former Northeast Sewage Treatment Plant (sheriff's training facility).

To a lesser degree, Xerorthents and Riverwash soils also exist at the Arden Bar site. Xerorthents are formed from the results of dredge tailings and are rapidly draining cobble and gravel pockets that have had the finer sediments filtered out during gold-dredging activities. Riverwash soils are also found on the site, although primarily at the north end of the site and the very limits of the site study area. These are stratified soils containing silt, sand, gravel, and cobble sediments immediately adjacent to the river channel. However, since the construction of the upstream dams, many of the finer sediments have been washed downstream and are not being replaced by sediment transported from the upper reaches of the watershed. (U.S. Soil Conservation Service 1993)

Hydrology. Much of the site has been shaped by the past mining activities on the site. This is most evident in the creation of the channel and backwater areas punctuated with sand and gravel bar islands at the north/northeast area of the site. Because the riverflows are now regulated by upstream dams, very little sediment is deposited on this site. Riverflows have managed to shape the pits and mounds from the mining era into more fluvial landforms. Moderate flows will pass over the gabion retaining wall and enter Arden Pond. An outlet point at the pond's southernmost point regulates the water surface level. Groundwater, rain, and occasional riverflows appear to be the primary sources for water in the pond.

During December to January, the river exceeds the elevation of the gabion retaining wall approximately 10 percent of the time and river water flows into the pond. From December to May, the low-elevation bench at the outermost point of the bar is inundated approximately 25 percent of the time. This area supports the densest riparian vegetation on the site and is the most frequently inundated portion of the site.

Vegetation

There are three primary classifications of vegetation on the site. The developed parkland and the sheriff's training facility consist primarily of mature specimen, nonnative tree species, and manicured lawn, although some native oak trees are among the plantings. On the high flood plain between the developed parkland and the pond and on a small 1-acre area south of the pond on the bluff is primarily ruderal vegetation intermixed with an occasional cottonwood. The nonnative invasive yellow star-thistle is present in both of these areas. Depressions on the site, the channel extending north from the pond, and an approximately 16-acre area south and adjacent to the pond are primarily willow and cottonwood associations. The low bench immediately below the bluff and adjacent to the river is a primarily mixed riparian forest, including large numbers of ash and alder trees. This area is quite dense and appears to be high in plant species diversity, including willows, grape, cottonwoods, sedges, and rushes.

The areas along the perimeter of the pond and at the outlet of the pond (the southernmost corner near the river) are infested with nonnative invasive species, primarily scarlet wisteria. The sand and gravel bars and the cobble areas on the site have become heavily infested with this rapidly spreading nonnative plant. The presence of this plant was first noted in the American River corridor in approximately 1995. This plant spreads by seed pods and constitutes a threat for riparian areas downstream where these seed pods can be deposited by flows from the river.

Fish and Wildlife

While some waterfowl are taking advantage of the open water afforded by the pond, and the pond is stocked with fish, the opportunities for native wildlife to use this site are limited. Most of the riparian edge areas are degraded or too narrow to provide sufficient foraging, cover, or shelter. The pits between the main river channel and the adjacent higher flood plain do provide excellent spawning gravel for some species. Several salmon were observed in the fall resting in near the shore and traversing the riffles upstream. However, when water levels drop,

there is the potential for stranding in these pits, leaving salmon susceptible to predatory fish. At moderate flows that breach the gabion retaining wall, it is likely that native fish species are swept into the pond and stranded when the water level recedes. The large patch of mixed riparian and cottonwood forest located on the point between the pond and the river most likely provides good habitat for avian species; however, it is an isolated patch adjacent to mostly ecologically degraded areas.

The presence and activities of the sheriff's training facility likely prohibit many larger resident species (e.g., deer, fox, coyote, and mountain lion) from traveling to locations farther downstream. In fact, this site is likely a severe constraint to movement by terrestrial wildlife in the corridor. Wildlife are restricted to the narrow strips between the levee and the pond, or the maintenance road, which provide very little cover for larger species.

Cultural Resources

The records search indicated that two cultural resources studies have been conducted in the proposed Arden Bar restoration site. Intensive survey coverage was accomplished by a linear survey comprising three-quarters of a mile (Nilsson et al. 1995). Cursory survey coverage of the restoration site was conducted by Ann S. Peak, which encompassed approximately 269 acres (Ann S. Peak & Associates 1973, 1978; Peak 1999). There are no previously recorded resources within the proposed Arden Bar restoration site.

There have been nine cultural resource surveys conducted adjacent to or within 1/4 mile of the Arden Bar restoration site (Dames and Moore 1995; Nilsson et al. 1995; Ann S. Peak & Associates 1973, 1978; Rondeau and Dougherty 1978; Slaymaker 1987; True 1984; Warner 1992). Additionally, nine previously recorded resources are located within 1/4 mile (Boloyan and Payen 1958; Dames and Moore 1995; Ann S. Peak & Associates 1973; Pilling 1949).

Native American Consultation. Glen Villa of the Cultural Committee of the Ione Band of the Miwok Indians noted that maps and literature produced by anthropological studies of the Nisenan and Miwok locate villages in the vicinity of the proposed Arden Bar restoration site. Ethnographic maps (Bennyhoff 1977: Maps 2–3; Kroeber 1925: Plate 37; Wilson and Towne 1978: Plate 1) indicate that village sites were located near the Arden Bar restoration site; however, the map scales are coarse, so village locations can only be poorly estimated in relation to the proposed restoration sites.

Potential Cultural Resources. Two historic road segments and two structures were located in the proposed restoration site but are not discernible on modern aerial photographs (U.S. Geological Survey 1950, 1954b). Historic maps (U.S. Geological Survey 1950, 1954b) also indicate that historic mine tailings are likely located in the Arden Bar restoration site.

Recommendations. Adequate, recent survey coverage of the Arden Bar restoration site consists of a cultural resources inventory conducted along the north levee (Nilsson et al. 1995). Other surveys (Ann S. Peak & Associates 1973, 1978; Peak 1999) either covered a minimal portion of the proposed restoration site or were conducted more than 10 years ago. To comply

with Section 106 of the NHPA and professional archaeological protocol, the Arden Bar restoration site needs to be surveyed for cultural resources, except for the north levee.

One previously recorded cultural resource, a historic levee, is located in the proposed restoration site. This historic levee would have to be evaluated for NRHP eligibility through historical research. If CA-SAC-481H is recommended eligible for NRHP listing, an assessment of project effects on the levee would be conducted and appropriate mitigation measures developed.

Without-Project Conditions

Stranding of native, anadromous fish species and the establishment of nonnative plant species are two of the most prominent conditions threatening the ecological integrity of the Arden Bar site. With the recent listings of the spring-run chinook salmon as a federally listed endangered species, exhaustive efforts are being made to understand how to bring the species back to the river. A big threat to the species' survival is the presence of the pond and the mining pits, which are ideal refuge for salmonid predators. This will continue to be a problem at this site if present conditions remain. The rapid colonization of unvegetated sand and cobble bars by scarlet wisteria is of real concern. In approximately 6 years, this plant has covered approximately 40-50 acres of this site. It is likely that this aggressive plant will continue to occupy and grow in areas not only on this site, but downstream. It is highly opportunistic, and without aggressive eradication or management threatens to continue to displace native vegetation in the corridor. In turn, this will affect the wildlife that depend on an abundance of native vegetation for food, forage, and shelter.

The levee surrounding the sheriff's training facility is presently a nonconforming use in the American River Parkway, and neither it nor the developed facilities behind it provide any ecological value to resident wildlife species. It will continue to be an obstacle for larger terrestrial species that require large areas to roam for food. The presence of the facility and its levee also reduce the opportunity to establish native plant communities on the site. Finally, levee removal would allow better floodflow conveyance in this reach, thereby reducing scouring forces on vegetation and the ground surface across the width of the existing floodway.

Plate 8 summarizes the without-project conditions at the Arden Bar site.

Summary of Opportunities and Constraints

The following constraints should be considered when developing a restoration strategy for the Arden Bar site:

- Vehicular access to each telephone pole must be maintained.
- The site would require further cultural resource investigation to comply with Section 106 of the NHPA.

- Trails and fishing access points may need to be rerouted and/or relocated.

- Removing the sewage treatment facilities and the levee surrounding them is likely to be very costly, even considering the reuse of some of the material as fill on-site.

- Eradication of scarlet wisteria will require a funded, long-term strategy to complete remove it from the site.

- Existing, moderate- to high-quality native vegetation should not be disturbed by restoration activities when possible.

The existing site conditions provide the following opportunities for developing a restoration strategy for the Arden Bar site:

- By reducing the size of the pond and raising the elevation of the maintenance road, stranding of native fish species could be reduced.

- Riparian habitat could be increased by reshaping the pond and regrading its banks to gentler slopes to allow wider bands of riparian vegetation.

- Terrestrial wildlife movement in the river corridor and river hydraulics could be improved by removing the levee surrounding the sheriff's training facility.

- Eradicating and controlling nonnative invasive species and replacing with site appropriate native plants would increase local biodiversity and improve the ecological integrity of the site.

- Allowing more moderate flows to pass through the site via a high flow bypass would decrease erosion on the south bank while also improving shallow aquatic habitat conditions at the downstream portion of the site for the benefit of anadromous fish species.

Plate 9 summarizes the problems and opportunities associated with the Arden Bar site.

SECTION 3.0

PLAN FORMULATION

Under Corps guidelines, the purpose of ecosystem restoration is to restore significant ecosystem function, structure, and dynamic processes that have been degraded. The intent of restoration is to reestablish the attributes of a naturalistic, functioning, and self-regulating system. The formulation of this plan focuses on this stated purpose and intent. The project team evaluated four different sites (Urrutia, Woodlake, Bushy Lake, and Arden Bar) within the context of the opportunities and constraints outlined in Section 2.0 and developed ecosystem restoration goals. Field reconnaissance, literature research, and aerial photographs were the principal tools used to develop potential restoration measures for each site as well as coordination with the USFWS. Various combinations of the measures will be analyzed to produce a final plan that achieves restoration goals and objectives.

3.1 Restoration Goals

The following goals guided the formulation of restoration objectives and measures for the four sites:

Goal 1: Restore geomorphic/hydraulic conditions that will support diverse, robust habitats.

Goal 2: Restore diverse native plant communities.

Goal 3: Restore habitat for native fish and wildlife.

Goal 4: Establish connectivity between proposed and existing habitats.

Goal 5: Reestablish hydrologic interaction between the flood plain and the river channel.

Goal 6: Reduce potential for fish stranding on the flood plain.

3.2 Restoration Objectives

Based on the aforementioned goals, 11 objectives were developed to complement and provide focus to these goals. Some objectives are intended to meet more than one goal.

Objective 1: Control nonnative invasive plant species.

To varying extents, nonnative invasive plant species cover significant areas in the Lower American River corridor: giant reed (*Arundo donax*), scarlet wisteria (*Sesbania punicea*), Himalayan blackberry (*Rubus discolor*), black locust (*Robinia pseudoacacia*), sweet fennel (*Foeniculum vulgare*), and yellow star-thistle (*Centaurea solstitialis*). They displace native plant

species that native wildlife using the corridor depend on for food, shelter, and nesting and reduce the biodiversity of the flood plain ecosystem.

Objective 2: Create seasonal wetlands.

The shallow and slow-moving waters of seasonal wetlands provide ideal spawning and resting habitat for native fish, including Sacramento splittail, salmon, and steelhead. Seasonal wetlands connecting the active channel to the flood plain contribute to the ecological biodiversity of the corridor. These flood plain features include flood channels, side channels, and margins of sloughs. The function of many of these wetlands has been lost since the river morphology was changed by hydraulic mining and was harnessed for flood control purposes. As the flows of the river have sought to reestablish the predisturbance channel profile and sediment has been prevented from entering the system, the riverbed elevation has lowered, leaving the previously connected wetlands abandoned on the high, dry, and infrequently flooded surfaces of the limited, remaining flood plain. Restoring the ecological function of these wetlands will increase suitable habitats available for the benefit of native fish populations.

Objective 3: Expand native riparian forest plant community.

Riparian forests are presently limited to narrow, steep strips adjacent to the river, Steelhead Creek/Bannon Slough, and the borrow channels adjacent to levees. Expansion of these forests has been limited to these areas through historic and present land management practices, deepened water tables, and the reduction in areas of frequently inundated soils required for their natural germination, dispersal, and growth. Reconstructing seasonally inundated flood plain benches by reducing steep slopes adjacent to waterways, and planting native plant species will allow the riparian forest plant communities to naturally regenerate.

Objective 4: Expand native oak woodlands.

Before construction of levees and conversion of land into agriculture and urban development, much of the higher elevations in the Lower American River flood plain had expanses of oak woodlands. Although remnants of these woodlands remain in small patches, they are greatly fragmented. The quality of these areas for wildlife habitat is a direct function of the presence of large, contiguous oak woodlands. Reestablishing oak trees (*Quercus* spp.) and their associated species, such as elderberry (*Sambucus mexicana*) and black walnut (*Juglans hindsii*), will provide excellent habitat for both terrestrial and avian native wildlife species of the river corridor.

Objective 5: Restore native grasslands.

Most of the grasslands once covering the drier soils of the flood plain have been converted to other uses since the area was settled. Currently, most remaining grasslands have been infested and fragmented by large stands of nonnative invasive species or have become covered with more woody species as historical, cultural practices of burning grasslands have been eliminated from the landscape. Grasslands provide habitat for many small mammals that

inhabit the river corridor. Their open, uncanopied nature is an ideal characteristic for raptor species seeking prey. Restored grasslands, once established, can help minimize the ability of nonnative invasive species to establish. Grasslands are an important element of maintaining the food web of the flood plain ecosystem.

Objective 6: Create forage and cover for native wildlife species.

The corridor is host to a wide diversity of birds, waterfowl, and small mammals. Some species calling the Lower American River home are raccoons, voles, rabbits, foxes, deer, coyote, beaver, and river otter. Some surveys have counted more than 150 different avian species on the Cal Expo flood plain alone. Creating diverse habitats on the flood plain will provide the forage and cover needed to sustain these diverse populations.

Objective 7: Create shaded riverine areas.

Shaded riverine aquatic cover consists of low, overhanging vegetation and instream woody material (e.g., branches and trunks of trees) that provide overhead, instream, and thermal cover for rearing juvenile salmon and steelhead. As woody riparian vegetation has been removed from, or failed to regenerate on, the flood plain, and as bar building has been arrested, both old and new sources of overhanging and instream vegetation have diminished. Recreating shaded riverine aquatic cover will benefit native fish species.

Objective 8: Create shallow aquatic habitat.

Shallow shoreline depths (1-3 feet) with emergent aquatic vegetation and instream woody material have largely disappeared from the Lower American River because of channel incision. These areas provide valuable habitat for rearing of native fish species and are a critical link in restoring ecological integrity to the Lower American River corridor.

Objective 9: Reduce barriers to flood plain inundation.

Many of the banks immediately adjacent to the river are high relative to the adjacent flood plain, which precludes moderate flows in the river from inundating areas that were historically flooded by such flows. Some of these barriers were constructed to protect flood plain lands for agriculture, now abandoned. Lowering these barriers would assist in restoring the important ecological process of frequent inundation of the flood plain.

Objective 10: Lower flood plain elevations.

As the flood plains have become abandoned from the influences of the river channel, the ecosystem has been altered. Species favoring infrequent inundation and not dependent on shallow water tables and many nonnative, invasive species have taken advantage of the altered system and, in effect, reduced the ecological integrity of the flood plain ecosystem. Lowering elevations in areas of the flood plain is necessary to support native flood plain woody riparian species that require shallower groundwater and more frequent inundation from the river, Bannon

Slough, or one of the borrow channels. An additional benefit of lowering flood plain elevations is the opportunity to reduce isolated low areas on the flood plain that may trap native fish during high flows.

Objective 11: Direct overland flows away from isolated wetlands and open waters.

Currently the flood plain contains several areas that trap native fish when overbank flows recede from the flood plain. Examples of these areas are the mining pits at Arden Bar and Urrutia, Bushy Lake, and the borrow trench and the large depressional wetland on the Woodlake site. Providing positive drainage toward the river or toward Bannon Slough can reduce this threat to the native fish species.

3.3 Planning Constraints

Consideration was given to several planning criteria during development of the goals, objectives, and restoration measures:

- Proposed restoration activities will be consistent with the RCMP for the Lower American River.
- Existing high-quality wildlife habitat, fisheries habitat, and native plant communities (including VELB habitat) will not be disturbed by restoration activities.
- American River Parkway recreation activities and use levels will be maintained (although relocation or rerouting of recreational facilities may be recommended).
- Existing major utility, gas, sewer, cable, and telephone infrastructure will remain in place and access maintained (minor infrastructure may be considered for relocation at public expense).
- The flood capacity of the floodway will be maintained.
- Proposed restoration activities will be self-sustaining, requiring little long-term maintenance.

SECTION 4.0

RESTORATION MEASURES EVALUATED

Measures are direct actions taken to achieve the restoration goals and objectives. The following measures were developed to meet multiple objectives discussed as benefits and issues of significance.

4.1 Measure 1. Control Nonnative Invasive Plant Species Using Herbicide and Mechanical (Cutting, Mowing, Manual Extraction) Methods.

4.1.1 Description of Actions

Controlling nonnative invasive plant species can be done through a combination of mowing or cutting and the application of an herbicide. Mowing should be done before the plants release seed. After control measures have been implemented, replant treated areas with native plant species as specified on the plan. Densely infested areas (80-100 percent cover) could be delineated and management and control of species limited to areas immediately adjacent to the delineated area. Because neither chemicals nor mowing has proven 100 percent effective in eradicating yellow star-thistle, maintenance and control for this species is recommended for the life of the project. Other target species on which this method would be effective are giant reed, Himalayan blackberry, sweet fennel, black locust, Spanish broom, and scarlet wisteria.

4.1.2 Issues of Significance

Nonnative invasive plant species thrive on sites where the soil and hydrological conditions have been altered through human-induced disturbances. Their presence prevents native plant communities from becoming reestablished, disrupts the food web of native wildlife species, and reduces biodiversity.

4.1.3 Performance Standards

The success of a nonnative invasive plant control program can be determined by observing reduced germination of plants in successive years within a treated area. Eighty-percent eradication is a minimal, desirable future condition after 5 years of treatment.

4.1.4 Benefits

Habitat

This measure will aid in the recovery of native plant communities.

Nonhabitat

No nonhabitat benefits have been identified although native vegetation communities may have greater aesthetic value and favorable public perception.

4.1.5 Costs

The following tables identify the cost per acre of the measure and the range of acres at each site to which each measure could be applied.

Costs (per acre)	
Construction/startup:	$50 per acre (herbicide)
	$1,000 per acre (mechanical)
Operations, maintenance, and monitoring:	$50 per acre per year

O&M interval: every year

Areas of Potential Applicability

Site	Areas in Site	Acreage
Urrutia	All non-open water areas	90-110
Woodlake	All	180-280
Bushy Lake	All non-open water areas	125-334
Arden Bar	All non-open water areas	85-252

Establishment Period

Not applicable.

Nonmonetary Costs

Temporary exclusion of recreation activities from the sites being treated would be required.

4.2 Measure 2. Control Nonnative Invasive Plant Species through Burning.

4.2.1 Description of Actions

An annual burning regime can be effective in controlling nonnative invasive plant species. Burning should occur before plants go to seed and before the area has completely dried out so as to prevent fire escape when atmospheric conditions allow for optimal smoke dispersion.

4.2.2 Issues of Significance

Nonnative invasive plant species thrive on sites where the soil and hydrologic conditions have been altered through human-induced disturbances. Their presence prevents native plant communities from becoming reestablished, disrupts the food web of native wildlife species, and reduces biodiversity.

4.2.3 Performance Standards

The success of a nonnative invasive plant control program can be determined by observing reduced germination of plants in successive years within a treated area. Eighty-percent eradication is a minimal, desirable future condition after 5 years of treatment.

4.2.4 Benefits

Habitat

This measure will aid in the recovery of native plant communities.

Nonhabitat

No nonhabitat benefits have been identified although native vegetation communities may have greater aesthetic value and favorable public perception.

4.2.5 Costs

The following tables identify the cost per acre of the measure and the range of acres at each site to which each measure could be applied.

Costs (per acre)	
Construction/startup:	$50 per acre
Operations, maintenance, and monitoring:	$50 per acre

O&M interval: every 3 years

Areas of Potential Applicability

Site	Areas in Site	Acreage
Urrutia	Higher flood plain areas with ruderal vegetation	10-50
Woodlake	Higher flood plain areas with ruderal vegetation	10-130
Bushy Lake	Higher flood plain areas with ruderal vegetation	10-30

Establishment Period

Not applicable.

Nonmonetary Costs

Temporary exclusion of recreation activities from the sites being treated would be required.

4.3 Measure 3. Remove Nonnative Invasive Plant Species through Excavation of the Seed Bank.

4.3.1 Description of Actions

By excavating the top 6-12 inches of soil and removing the material from the site, nonnative invasive plant species can be eradicated. This method is particularly useful in eradicating yellow star-thistle. This action also has the added benefit of lowering the flood plain. The excavated material could be used to fill open waters and pits because the seeds for most of these species, especially yellow star-thistle, will not germinate under water. Another option, if the soil is suitable, would be to store it offsite and use it for levee construction material. Even with long-term herbicide and burning management programs, star-thistle seeds tend to persist in the topsoil layers. Once established, grasslands can outcompete yellow star-thistle. Other target species for this method would be sweet fennel and giant reed.

4.3.2 Issues of Significance

Nonnative invasive plant species thrive on sites where the soil and hydrological conditions have been altered through human-induced disturbances. Their presence prevents native plant communities from becoming reestablished, disrupts the food web of native wildlife species, and reduces biodiversity.

4.3.3 Performance Standards

The success of a nonnative invasive plant control program can be determined by observing reduced germination of plants in successive years within a treated area. Eighty-percent eradication is a minimal, desirable future condition after 5 years of treatment.

4.3.4 Benefits

Habitat

This measure will aid in the recovery of native plant communities and can increase the frequency of flood plain inundation.

Nonhabitat

No nonhabitat benefits have been identified.

4.3.5 Costs

The following tables identify the cost per acre of the measure and the range of acres at each site to which each measure could be applied.

Costs (per acre)	
Construction/startup:	$12,500 per acre (1 foot of cut @ $7.50/cubic yard)
Operations, maintenance, and monitoring:	None

O&M interval: not applicable

Areas of Potential Applicability

Site	Areas in Site	Acreage
Urrutia	Higher flood plain and other infested areas	100
Woodlake	Higher flood plain and other infested areas	130
Bushy Lake	Higher flood plain and other infested areas	110
Arden Bar	Higher flood plain and other infested areas	85

Establishment Period

Not applicable.

Nonmonetary Costs

Temporary exclusion of recreation activities from the sites being treated would be required.

4.4 Measure 4. Plant Seasonal Wetland Plant Species.

4.4.1 Description of Actions

Plant plugs of rushes (*Juncus* spp.) and tules (*Scirpus acutus*) at 10 feet on center. Species should be planted in clusters typically in areas where the hydraulic conditions are such that seed from the plugs will be carried to unplanted areas. No irrigation is recommended for seasonal wetland areas; however, the site should be maintained for 5 years by keeping it weed free and replacing dead plants as necessary.

4.4.2 Issues of Significance

This measure addresses the historical loss of seasonal wetlands in the Lower American River flood plain. Very little seasonal wetlands of any quality remain at present.

4.4.3 Performance Standards

Initially planted species should have an 80- to 100-percent survival rate over the first 3 years. Unplanted areas should begin to show evidence of recruitment of native wetland plant species. At the end of 5 years, the wetland should have 100-percent coverage of native wetland species.

4.4.4 Benefits

Habitat

This measure will increase the amount of seasonal wetland habitat available for use by native wildlife species for nesting and forage.

Nonhabitat

No nonhabitat benefits of this measure have been identified.

4.4.5 Costs

The following tables identify the cost per acre of the measure and the range of acres at each site to which each measure could be applied.

Costs (per acre)	
Construction/startup:	$7,000 per acre
Operations, maintenance, and monitoring:	$1,500 per acre per year

O & M interval: 5 years during the first 10 years; once every 5 years thereafter

Areas of Potential Applicability

Site	Areas in Site	Acreage
Woodlake	West	2-15

Establishment Period

10 years for full-functioning value.

Nonmonetary Costs

No nonmonetary costs for this measure have been identified.

4.5 Measure 5. Grade the Flood Plain to Lower Flood Plain Elevations to Levels that can Support Seasonal Wetland Species (Including Plant Installation).

4.5.1 Description of Actions

Precise grades for the appropriate hydrology at each site should be determined before excavation and planting. Excavated material may be used onsite to develop landforms or would need to be removed from the site for disposal, stockpiled for levee construction material, or used for restoration purposes at other sites in the Lower American River corridor. Graded areas would be planted with native wetland plant species or designed to allow for the creation of seasonally inundated mudflats.

4.5.2 Issues of Significance

This measure addresses the historical loss of seasonal wetlands in the Lower American River flood plain. Very little seasonal wetlands of any quality remain at present.

4.5.3 Performance Standards

Initially, planted species should have an 80- to 100-percent survival rate over the first 3 years. Unplanted areas should begin to show evidence of recruitment of native wetland plant species. At the end of 5 years, the wetland should have 100-percent coverage of native wetland species.

4.5.4 Benefits

Habitat

This measure will increase the amount and quality of seasonal wetland habitat available for use by native wildlife species for nesting and forage.

Nonhabitat

Seasonal wetlands can assist in improving water quality by providing additional filtration and uptake of nutrients and contaminants associated with urban runoff.

4.5.5 Costs

The following tables identify the cost per acre of the measure and the range of acres at each site to which each measure could be applied.

Costs (per acre)	
Construction/startup:	$33,000 per acre
Mobilization:	$1,000 per acre
Earthwork:	$25,000 per acre
	(2 feet of cut @7.50/cubic yard)
Planting:	$7,000 per acre
Operations, maintenance, and monitoring:	$1,500 per acre per year

O&M interval: 5 years during the first 10 years; once every 5 years thereafter

Areas of Potential Applicability

Site	Areas in Site	Acreage
Bushy Lake	Perimeter of lake	16–22
Woodlake	West	2–15

Establishment Period

10 years for full-functioning value.

Nonmonetary Costs

Where existing low-quality habitats are to be improved, temporary displacement of wildlife species using that wetland may occur while new wetlands are graded and planted.

4.6 Measure 6. Plant Riparian Forest Species.

4.6.1 Description of Actions

The following species with their corresponding size at time of planting are recommended for areas designated to be planted as riparian forest:

Common and Scientific Names	Size
Fremont cottonwood (*Populus fremontii*)	24-inch cuttings
Sycamore (*Platanus racemosa*)	1 gallon
Oregon ash (*Fraxinus latifolia*)	1 gallon
Box elder (*Acer negundo*)	1 gallon
White alder (*Alnus rhombifolia*)	1 gallon
Red willow (*Salix laevigata*)	24-inch cuttings
Yellow willow (*Salix lasiondra*)	24-inch cuttings
Sandbar willow (*Salix hindsiana*)	24-inch cuttings
Goodding's willow (*Salix gooddingii*)	24-inch cuttings
California blackberry (*Rubus ursinus*)	1 gallon

It is recommended that tree species be planted at 15 feet on center. Plastic shelters are recommended for all tree species to prevent damage from beavers and deer browse. Irrigate rooted material only for 1 year using time-released water package (TRWP) gel cartridges. Maintain for 5 years by keeping weed free, replacing dead plants, replacing the TRWPs and tree shelters as necessary.

4.6.2 Issues of Significance

Due to the altered hydrology of the Lower American River flood plain and competition from nonnative invasive species, riparian forest species are not regenerating.

4.6.3 Performance Standards

Some mortality can be expected from deer browse and beaver damage. While it is not possible to predict mortality from wildlife, the success of the riparian forest becoming self-sustaining is dependent on maintaining survival rates above 80 percent.

4.6.4 Benefits

Habitat

The size of riparian forest areas would be enlarged, providing better cover, shelter, and nesting habitat for migratory songbirds and other native wildlife.

Nonhabitat

No nonhabitat benefits for this measure have been identified.

4.6.5 Costs

The following tables identify the cost per acre of the measure and the range of acres at each site to which each measure could be applied.

Costs (per acre)	
Construction/startup:	$8,000 per acre
Planting:	$4,000 per acre
($20/plant @ 200 plants/acre)	
Irrigation:	$4,000 per acre
	($20/plant/year @ 200 plants/acre for hydrating gel supplements)
Operations, maintenance, and monitoring:	$2,500 per acre per year

O&M interval: 5 years during the first 10 years; once every 5 years thereafter

Areas of Potential Applicability

Site	Areas in Site	Acreage
Bushy Lake	Edges of Bushy Lake	2-4
Arden Bar	Island in pond	1
Woodlake	Adjacent to depressional wetland	6-10

Establishment Period

5 years for establishment, 50 years for full-functioning value.

Nonmonetary Costs

No nonmonetary costs for this measure have been identified.

4.7 Measure 7. Lower Flood Plain Elevations to a Level that will Support Riparian Forest Species (Including Plant Installation).

4.7.1 Description of Actions

Each site requires specific grading to achieve the appropriate hydrology to support riparian forest species. Excavated material may be used onsite to develop landforms or would need to be removed from the site for disposal, stockpiled for levee construction material, or used for restoration purposes at other sites in the Lower American River corridor.

It is recommended that tree species (see plant list under Measure 6) be planted at 15 feet on center. Plastic shelters are recommended for all tree species to prevent damage from beavers and deer browse. Irrigate rooted material only for 1 year using time-released water package (TRWP) gel cartridges. Maintain for 5 years by keeping weed free, replacing dead plants, replacing the TRWPs and tree shelters as necessary.

4.7.2 Issues of Significance

Due to the altered hydrology of the Lower American River flood plain and competition from nonnative invasive species, riparian forest species are not regenerating.

4.7.3 Performance Standards

Some mortality can be expected from deer browse and beaver damage. While it is not possible to predict mortality from wildlife, the success of the riparian forest becoming self-sustaining is dependent on maintaining survival rates above 80 percent.

4.7.4 Benefits

Habitat

The size of riparian forest areas would be enlarged, providing better cover, shelter, and nesting habitat for migratory songbirds and other native wildlife.

Nonhabitat

No nonhabitat benefits for this measure have been identified.

4.7.5 Costs

The following tables identify the cost per acre of the measure and the range of acres at each site to which each measure could be applied.

Costs (per acre)	
Construction/startup:	$34,000 per acre
Mobilization:	$1,000 per acre
Earthwork:	$25,000 per acre
	(2 feet of cut @ $7.50/cubic yard)
Planting:	$4,000 per acre
Irrigation:	$4,000 per acre
($20/plant/year @ 200 plants/acre for hydrating gel supplements)	
Operations, maintenance, and monitoring:	$2,500 per acre per year

O&M interval: 5 years during the first 10 years; once every 5 years thereafter

Areas of Potential Applicability

Site	Areas in Site	Acreage
Urrutia	Adjacent to Bannon Slough/flood plain	25–65
Woodlake	Southwest and near cross channel	4–16
Bushy Lake	Bushy Lake proper	15–22
Arden Bar	Along proposed high-flow channel and fish pond	5-31

Establishment Period

5 years for establishment; 50 years for full-functioning value.

Nonmonetary Costs

Temporary exclusion of passive recreational activities associated with Bushy Lake such as wildlife viewing or nature study and active recreation activities such as bicycling and running may be required to accommodate expansion of riparian areas adjacent to recreational trails.

4.8 Measure 8. Plant Riparian Oak Woodland Species.

4.8.1 Description of Actions

Plant the following species 30 feet on center. Tree species should be protected with plastic shelters.

Common and Scientific Names	Size
Valley oak (*Quercus lobata*)	50 percent acorns/50 percent 1 gallon
Black walnut (*Juglans hindsii*)	1 gallon
Oregon ash *(Fraxinus latifolia)*	1 gallon
California wild rose *(Rosa californica)*	1 gallon
California blackberry *(Rubus ursinus)*	1 gallon

Irrigate for 2 years using TRWP gel cartridges. Maintain for 5 years by keeping weed free, replacing dead plants, and replacing the TRWPs and tree shelters as necessary.

4.8.2 Issues of Significance

Much of the existing riparian valley oak woodland lies in small, fragmented remnant patches. Larger, connected expanses of oak woodland would provide better wildlife habitat.

4.8.3 Performance Standards

Sustaining planted oaks would rely heavily on supplemental irrigation for the first several years. The density of the planting factors in a loss of 10-15 percent of oak species. A minimum of 80-percent survival of planted oak species after 10 years is recommended.

4.8.4 Benefits

Habitat

The size of oak woodland areas would be enlarged, providing better cover, shelter, and nesting habitat for migratory songbirds and native wildlife.

Nonhabitat

Oak woodlands are becoming increasingly scarce in the metropolitan region. Implementing this measure would allow for the creation of oak woodland in the Sacramento metropolitan area.

4.8.5 Costs

The following tables identify the cost per acre of the measure and the range of acres at each site to which each measure could be applied.

Costs (per acre)	
Construction/startup:	$15,500 per acre
Mobilization:	$1,000 per acre
Earthwork:	$12,500 per acre
	(1 foot of cut @ $7.50/cubic yard)
Planting:	$1,000 per acre
Irrigation:	$1,000 per acre
($20/plant/year @ 50 plants/acre for hydrating gel supplements)	
Operations, maintenance, and monitoring:	$3,000 per acre for first monitoring year (for hydrating gel supplements); $2,000 per acre per year thereafter

O&M interval: 5 years during the first 10 years; once every 5 years thereafter

Areas of Potential Applicability

Site	Areas in Site	Acreage
Urrutia	East	5-11
Woodlake	South and north	4-12

Establishment Period

10 years for shrubs; 50 years for full-functioning value.

Nonmonetary Costs

Temporary exclusion of recreational activities from restored areas may be required during the first few years after the restoration plantings.

4.9 Measure 9. Plant Oak Savanna Species.

4.9.1 Description of Actions

The same species proposed for conversion to oak woodland are also recommended for oak savanna. The spacing, however, should be 150 feet for tree species and 50 feet for shrub

species or three shrub species for every oak/walnut planting on average. The planting pattern should take the form of clusters of trees and shrubs with significant open area between the plantings to retain the character of a savanna. The remaining area should be seeded with a native grass mix. Eradication of existing annual or perennial nonnative grasses would be required before seeding. All tree species should be protected with plastic shelters. Irrigate for 2 years using TRWP gel cartridges. Maintain for 5 years by keeping weed free, replacing dead plants, and replacing the TRWPs and tree shelters as necessary.

Common and Scientific Names	Size
Valley oak (*Quercus lobata*)	50 percent acorns/50 percent 1 gallon
Black walnut (*Juglans hindsii*)	1 gallon
Oregon ash *(Fraxinus latifolia)*	1 gallon
California wild rose *(Rosa californica)*	1 gallon
California blackberry *(Rubus ursinus)*	1 gallon

4.9.2 Issues of Significance

Extensive areas of oak savanna habitat have largely been lost in the Central Valley region as land has been converted for urban development and agriculture. Creating large, unfragmented areas of oak savanna will benefit the native wildlife species that rely on the niche provided by this plant community. Before development of the flood plains, mining, and the construction of levees, oak savanna plant communities in the lower reaches of Central Valley rivers would have been inundated periodically. However, because of soil conditions and the relative infrequency of flooding, plant communities more typically resemble adjacent upland, hillslope areas. Wildlife inhabiting these habitats would travel the short distance to the river's edge to feed on migrating salmon and salmon carcasses. The changes in many of the low-gradient valley streams have forced many wildlife species to retreat to higher elevation waterways and flood plains and urban areas for food.

4.9.3 Performance Standards

Sustaining planted oaks would rely heavily on supplemental irrigation for the first several years. The density of the planting factors in a loss of 10-15 percent of oak species. A minimum of 80-percent survival of planted oak species after 10 years is recommended.

4.9.4 Benefits

Habitat

The size of oak savanna areas would be enlarged, providing better cover, shelter, and nesting habitat for migratory songbirds and native wildlife. Connecting oak savanna habitat in the active flood plain to the riparian corridor would assist in increasing wildlife diversity within the river corridor.

Nonhabitat

Oak woodlands are becoming increasingly scarce in the metropolitan region. Implementing this measure would allow for the creation of oak woodland in the Sacramento metropolitan area.

4.9.5 Costs

The following tables identify the cost per acre of the measure and the range of acres at each site to which each measure could be applied.

Costs (per acre)	
Construction/startup:	$14,300 per acre
Mobilization:	$1,000 per acre
Earthwork:	$12,500 per acre
	(1 foot of cut @ $7.50/cubic yard)
Planting:	$400 per acre
	($20/plant @ 20 plants/acre)
Irrigation:	$400 per acre
	($20/plant @ 20 plants/acre for hydrating gel supplements)
Operations, maintenance, and monitoring:	$2,000 per acre for first monitoring year (for hydrating gel supplements); $1,500 per acre per year thereafter

O&M interval: 5 years during the first 10 years; once every 5 years thereafter

Areas of Potential Applicability

Site	Areas in Site	Acreage
Woodlake	Northeast and east	8-19
Bushy Lake	South	50-70
Arden Bar	Southwest, along maintenance road, riverbend	1.5-25

Establishment Period

10 years for shrubs; 50 years for full-functioning value.

Nonmonetary Costs

Temporary exclusion of recreational activities from restored areas may be required during the first few years after the restoration plantings.

4.10 Measure 10. Seed Grassland.

4.10.1 Description of Actions

Grade the flood plain before drilling or broadcasting seed. Use a native grass mix appropriate for flood plain ecosystems. No irrigation is recommended, but grasslands should be maintained as weed free for 5 years using spot-spraying of herbicides and manual removal of nonnative invasive species as necessary.

4.10.2 Issues of Significance

Grasslands of significant size have been in decline because of conversion to agriculture, development, and conversion to nonnative invasive species, such as yellow star-thistle. Although grasslands are more typical of drier, upland regions, they provide critical spawning habitat for Sacramento splittail and anadromous fish species during floodflows that cover the grasslands.

4.10.3 Performance Standards

Newly seeded grassland is susceptible to invasion by nonnative invasive species, such as yellow star-thistle. Aggressive eradication of nonnative species will improve the success of establishing native grassland. Target performance of the new grassland should be 90- to 100-percent coverage by native grasses.

4.10.4 Benefits

Habitat

Large, connected expanses of grassland are vital habitat for many native wildlife and provide excellent foraging for raptor species. Inclusion of grasslands in the active Lower American River floodway (between the levees) that will flood periodically would provide benefit to endangered anadromous (salmon and steelhead) fish species and Sacramento splittail.

Nonhabitat

Large native grasslands have disappeared in the metropolitan region. Implementing this measure would provide a means of reintroducing a regionally rare habitat type.

4.10.5 Costs

The following tables identify the cost per acre of the measure and the range of acres at each site to which each measure could be applied.

Costs (per acre)	
Construction/startup:	$3,000 per acre
Mobilization:	$1,000 per acre
Planting:	$2,000 per acre
Operations, maintenance, and monitoring:	$2,000 per acre per year

O&M interval: 5 years during the first 10 years; once every 5 years thereafter

Areas of Potential Applicability

Site	Areas in Site	Acreage
Urrutia	East	4-10
Woodlake	Interior	60-95
Bushy Lake	Southwest	10-40

Establishment Period

15 years for full-functioning value.

Nonmonetary Costs

Site preparation for installation of the grassland could disrupt existing burrows and displace small resident terrestrial wildlife. Close coordination with wildlife biologists would be required to minimize disruption and displacement.

4.11 Measure 11. Provide Down, Large Woody Material to Construct Brush Piles.

4.11.1 Description of Actions

Brush piles are used by wildlife as both shelter and nesting habitat. Collect down, large woody material from the site and place in loose piles around the site in scattered locations. The loose piles of material should have sufficient internal space for resident small mammals to use.

4.11.2 Issues of Significance

Because of the upstream existence of Folsom Dam and the abandonment of the flood plain by the main American River channel, very little recruitment of woody material makes its way onto the flood plain. Woody material used for shelter, cover, and nesting is valuable to native wildlife.

4.11.3 Performance Standards

The brush piles should be monitored annually to determine whether they are being used by wildlife.

4.11.4 Benefits

Habitat

Brush piles are used by wildlife as both shelter and nesting habitat.

Nonhabitat

Material from removed nonnative invasive tree species could be used for piles, reducing the need for disposal.

4.11.5 Costs

The following tables identify the cost per acre of the measure and the range of acres at each site to which each measure could be applied.

Costs (per structure)	
Construction/startup:	$500 per acre
(2 laborers for 1 day/pile/acre)	
Operations, maintenance, and monitoring:	$250 per acre per year
O&M interval: every 2 years	

Areas of Potential Applicability

Site	Areas in Site	Acreage
All	Higher flood plain areas	N/A

Establishment Period

Not applicable.

Nonmonetary Costs

No nonmonetary costs for this measure have been identified.

4.12 Measure 12. Manage Grassland as Hay Crop for Raptor Prey.

(This measure is no longer applicable to any of the four sites because it focuses on a management direction rather than an active restoration measure. It is included here to inform the reader of the range of measures considered.)

4.13 Measure 13. Modify Hydrology and Construct Side Channels Off the Main American River Channel and Plant Shallow Aquatic, Seasonal Wetlands and Riparian Forest Species.

4.13.1 Description of Actions

To provide suitable habitat for both Sacramento splittail and anadromous fish species, this measure proposes excavating a side channel into the flood plain. The intent of this channel is to provide habitat for splittail, salmon, and steelhead by establishing woody riparian vegetation in the flood plain and providing a connection to the river at the downstream end. Excavated material would need to be removed from the site for disposal, stockpiled for levee construction material, or used for restoration purposes at other sites in the Lower American River corridor. The resulting side channel should be planted with seasonal wetland and riparian forest species as outlined in Measures 4 and 6, respectively.

4.13.2 Issues of Significance

Sacramento splittail; Sacramento River winter-run, spring-run, and fall/late fall-run chinook salmon; and Central Valley steelhead are all suffering from changes in the aquatic habitats of the Lower American River; consequently, their presence has been severely reduced.

4.13.3 Performance Standards

The side channels should be monitored annually for use by fish and for stability of the banks to ensure that no sedimentation of the shallow aquatic area is occurring from adjacent banks or that degradation of the side channel is not resulting from floodflows.

4.13.4 Benefits

Habitat

This measure addresses specific needs of the endangered Sacramento splittail and salmon and steelhead fish species. This measure could assist in the recovery and return of these species to the American River system.

Nonhabitat

This measure may increase localized flood capacity of the channel.

4.13.5 Costs

The following tables identify the cost per acre of the measure and the range of acres at each site to which each measure could be applied.

Costs (per acre)	
Construction/startup:	$74,500 per acre
Mobilization:	$1,000 per acre
Earthwork:	$62,500 per acre
	(5 foot of cut @ $7.50/cubic yard)
Planting:	$7,000 per acre
Irrigation:	$4,000 per acre
	($20/plant/year @ 200 plants/acre for hydrating gel supplements)
Operations, maintenance, and monitoring:	$2,500 per acre per year

O&M interval: 5 years during the first 10 years; once every 5 years thereafter

Areas of Potential Applicability

Site	Areas in Site	Acreage
Urrutia	South	25-30
Woodlake	Southwest	30-34
Bushy Lake	Southeast	3-5

Establishment Period

5 years for establishment; 50 years for full-functioning value.

Nonmonetary Costs

No nonmonetary costs for this measure have been identified.

4.14 Measure 14. Construct a High-Flow Bypass Channel.

4.14.1 Description of Actions

A natural channel would be excavated near the active river channel so as to provide a high-flow bypass. Onsite cobble would be used to create the streambed. Banks of the channel may be planted with riparian scrub species, such as willow (see Measure 22). Excavated material may be used onsite to develop landforms or would need to be removed from the site for disposal, stockpiled for levee construction material, or used for restoration purposes at other sites in the Lower American River corridor. A control structure would be required at the inlet to the channel to ensure that only high flows go through the channel and to prevent the inlet from degrading. The outlet would be at an elevation of a few feet below the low-flow water surface and graded so as to provide a small permanent backwater slough off of the main river channel.

4.14.2 Issues of Significance

Sacramento splittail; Sacramento River winter-run, spring-run, and fall/late fall-run chinook salmon; and Central Valley steelhead are all suffering from changes in the aquatic habitats of the Lower American River; consequently, their presence has been severely reduced.

4.14.3 Performance Standards

The side channels should be monitored annually for use by fish and for stability of the banks to ensure that no sedimentation of the shallow aquatic area is occurring from adjacent banks or that degradation of the bypass channel is not resulting from floodflows.

4.14.4 Benefits

Habitat

The channel would provide lentic habitats beneficial to native anadromous fish.

Nonhabitat

High-flow bypass channels reduce hydraulic pressure on steep banks susceptible to erosion and could meet objectives of other flood protection planning efforts.

4.14.5 Costs

The following tables identify the cost per acre of the measure and the range of acres at each site to which each measure could be applied.

Costs (per acre)	
Construction/startup:	$73,500 per acre
Site engineering:	$10,000 per acre
Mobilization:	$1,000 per acre
Earthwork:	$60,500 per acre
	(5 feet of cut @ $7.50/cubic yard)
Planting:	$2,000 per acre ($20 per plant at 100 plants per acre)
Operations, maintenance, and monitoring:	$2,500 per acre per year

O&M interval: every 5 years

Areas of Potential Applicability

Site	Areas in Site	Acreage
Arden Bar	Riverside of fish pond	7

Establishment Period

Not applicable.

Nonmonetary Costs

No nonmonetary costs for this measure have been identified.

4.15 Measure 15. Terrace Steep, Degraded Riverbanks and Plant with Riparian Forest Species.

4.15.1 Description of Actions

Grade existing, steep banks with one bench at 10- to 20-foot minimum width. Additionally, an upper bench of the same size can be incorporated into the design. The measure would be designed to preserve existing mature vegetation where possible. Excavated material may be used onsite to develop landforms or would need to be removed from the site for disposal, stockpiled for levee construction material, or used for restoration purposes at other sites in the Lower American River corridor.

4.15.2 Issues of Significance

As the main channel of the American River has incised, its adjacent banks have become steep and unable to support riparian vegetation. Wide bands of riparian vegetation immediately adjacent to the main channel are critical areas for both terrestrial and aquatic wildlife species.

4.15.3 Performance Standards

The banks should be monitored annually for erosion and establishment of riparian forest species.

4.15.4 Benefits

Habitat

Creating benches in the bank and planting with riparian forest species would improve the quality of near-river habitat.

Nonhabitat

No nonhabitat benefits for this measure have been identified.

4.15.5 Costs

The following tables identify the cost per acre of the measure and the range of acres at each site to which each measure could be applied.

Costs (per acre):	
Construction/startup:	$133,000 per acre
Mobilization:	$1,000 per acre
Earthwork:	$121,000 per acre
	(10 feet of cut @ $7.50/cubic yard)
Planting:	$7,000 per acre
Irrigation:	$4,000 per acre
Operations, maintenance, and monitoring:	($20/plant/year @ 200 plants/acre for hydrating gel supplements)
	$2,500 per acre per year

O&M interval: 5 years during the first 10 years; once every 5 years thereafter

Areas of Potential Applicability

Site	Areas in Site	Acreage
Urrutia	Mining pit banks and adjacent to river	2.5-25
Bushy Lake	Southeast	4-10

Establishment Period

5 years for establishment; 50 years for full-functioning value.

Nonmonetary Costs

No nonmonetary costs for this measure have been identified.

4.16 Measure 16. Restore Connectivity between the River Corridor and Flood Plain by Lowering Berms.

4.16.1 Description of Actions

Artificial berms along the river's edge would be excavated to lower elevations to achieve more frequent inundation of adjacent seasonal wetlands and woody riparian habitats. Excavated material may be used onsite to develop landforms or would need to be removed from the site for disposal, stockpiled for levee construction material, or used for restoration purposes at other sites in the Lower American River corridor.

4.16.2 Issues of Significance

The artificial berms prevent moderate flows from the American River from inundating two areas that would function as seasonal wetlands surrounded by riparian forest. Reintroducing flows to these wetlands and riparian areas would increase the plant and wildlife diversity.

4.16.3 Performance Standards

The presence of water in these areas following a 1.5-year flow (minimum) would indicate that they are receiving enough water to support riparian and wetland species.

4.16.4 Benefits

Habitat

This measure would result in an increase of the scarce seasonal wetland habitats.

Nonhabitat

This measure would increase hydrological interaction between the main channel and the flood plain.

4.16.5 Costs

The following tables identify the cost per acre of the measure and the range of acres at each site to which each measure could be applied.

Costs	
Construction/startup:	$61,500 per acre
Mobilization:	$1,000 per acre
Earthwork:	$60,500 per acre
	(5 feet of cut @ $7.50/cubic yard)
Operations, maintenance, and monitoring:	$2,000 per acre per year

O&M interval: 5 years during the first 10 years; once every 5 years thereafter

Areas of Potential Applicability

Site	Areas in Site	Acreage
Woodlake	Southwest	1-2

Establishment Period

5 years for establishment; 50 years for full-functioning value.

Nonmonetary Costs

No nonmonetary costs for this measure have been identified.

4.17 Measure 17. Construct Low-Elevation Bank Benches in Interior Open Waters and Plant with Emergent Wetland Species.

4.17.1 Description of Actions

Plant plugs of emergent wetland species at 15 feet on center. The planting pattern should take the form of cluster planting so that the hydrology of the site can assist in carrying seeds from the plugs to unplanted areas. Recommended species for planting are cattails (*Typha latifolia*) and tules (*Scirpus acutus*). No irrigation is recommended. The site should be maintained weed free for 5 years.

4.17.2 Issues of Significance

The banks of both Arden Pond and Urrutia Pit are either devoid of vegetation or colonized by nonnative invasive plant species, thus reducing biodiversity and wildlife habitat at these sites. Benches with emergent vegetation will provide a transition between the open water area and the riparian scrub and forest species.

4.17.3 Performance Standards

The benches should be monitored for total cover of emergent wetland species.

4.17.4 Benefits

Habitat

Emergent wetlands provide excellent waterfowl and migratory bird nesting habitat and shelter.

Nonhabitat

The benches would provide a more gentle transition between the open water and the bank slope and assist with bank stabilization.

4.17.5 Costs

The following tables identify the cost per acre of the measure and the range of acres at each site to which each measure could be applied.

Costs	
Construction/startup:	$20,500 per acre
Mobilization:	$1,000 per acre
Earthwork:	$12,500 per acre
	(1 foot of cut @ $7.50/cubic yard)
Planting:	$7,000 per acre
Operations, maintenance, and monitoring:	$2,000 per acre

O&M interval: 5 years during the first 10 years; once every 5 years thereafter

Areas of Potential Applicability

Site	Areas in Site	Acreage
Urrutia	Edge of Urrutia pond	2-7
Arden Bar	Around fish pond	0.5-1.5

Establishment Period

10 years for full-functioning value.

Nonmonetary Costs

No nonmonetary costs for this measure have been identified.

4.18 Measure 18. Create Outlet Stream Channel from Bushy Lake to the American River, and Plant with Riparian and Wetland Vegetation.

4.18.1 Description of Actions

A naturalistic stream channel approximately 30’ wide from top of bank to top of bank would be excavated/designed to convey water from the southwest corner of Bushy Lake to the American River. The channel would begin to receive water when the water surface elevation of Bushy Lake begins to exceed 5’ in depth. In a conceptual design scenario using existing topographic data provided by Ayres Associates, this elevation was 24.5’. Excavated material could be reused onsite to fill in portions of Bushy Lake that were excavated at the time of the preliminary golf course development on the flood plain (in the 1970s) to achieve the objectives of Measures 5 and 7. The banks of the channels would be planted primarily with wetland

vegetation. Some riparian forest species would be planted to increase wildlife habitat adjacent to the channels. The precise width-to-depth ratio of the channels would be determined by analyzing the total hydrology available to the flood plain. To avoid infestation of the newly created channels by nonnative invasive species, the areas would need to be planted immediately and maintained until the ground vegetation has filled in or through the life of the project.

4.18.2 Issues of Significance

Bushy Lake is in ecological decline partially as a result of years of wildly fluctuating water levels in the lake sustained by pumping groundwater from a pump located on the Cal Expo property north of the levee. Through implementation of a water management plan and the installation of measures 19 and 25, this measure will assist in the control of the water level of the lake to achieve desired habitat goals and use the excess water to provide much-needed seasonal wetland and riparian habitat on what is now an unnaturally high flood plain.

4.18.3 Performance Standards

The channel would be designed so that the available water would be sufficient to support the new wetland and riparian forest vegetation. Monitoring would be required to ensure vegetation establishment and erosion control.

4.18.4 Benefits

Habitat

The primary beneficiaries of this measure would be fish species, insects, and microorganisms in the Lower American River. These species are a key link in the food web of the corridor, thereby providing benefit for avian and terrestrial species. The wetland and riparian vegetation would provide benefit to bird species by creating nesting habitat.

Nonhabitat

It is likely that the vegetation lining the channel will further assist in the uptake of nutrients and contaminants remaining in the water exiting from Bushy Lake.

4.18.5 Costs

The following tables identify the cost per acre of the measure and the range of acres at each site to which each measure could be applied.

Costs (per acre)	
Construction/startup:	$33,000 per acre
Mobilization:	$1,000 per acre
Earthwork:	$25,000 per acre
	(2 feet of cut @ $7.50/cubic yard)
Planting:	$7,000 per acre
Operations, maintenance, and monitoring:	$1,500 per acre

O&M interval: 5 years during the first 10 years; once every 5 years thereafter

Areas of Potential Applicability

Site	Areas in Site	Acreage
Bushy Lake	From and into Bushy Lake	1-5

Establishment Period

5 years for establishment; 50 years for full-functioning value.

Nonmonetary Costs

The creation of the channel and planting of vegetation would displace existing ruderal grasslands.

4.19 Measure 19. Improve Water Quality Flowing into American River from Chicken Ranch and Strong Ranch Sloughs by Diverting Water Flows Above 2 cfs through a Storage Wetland and into Bushy Lake.

4.19.1 Description of Actions

This measure calls for diverting water from Chicken and Strong Ranch Sloughs into a 6-acre constructed wetland sited immediately adjacent and east of Bushy Lake and, after a residence time of 7-10 days, into Bushy Lake. An 1800 rpm lift pump would be installed between the levee and the existing detention basin on the north side of the levee at the end of Ethan Way. Depending on the desired water management level for Bushy Lake and the season, 1 – 3 cfs would be pumped from the sloughs through approximately 2300' of 16" PVC pipe before being discharged into the wetland. The pump would be located on the north bank of the levee between the flood plain and the detention basin. Water would be drawn into the pump system from the sloughs below their convergence at the north end of the basin, but before the water passes through the levee into the flood plain.

The wetland would be created by excavating approximately 2' down into the floodplain and using the excavated material to create a berm around the perimeter of the wetland. The berm would be wide enough (8-10 feet approx.) to allow for its use by maintenance vehicles and about 2' higher than the existing floodplain elevation. The berms would be seeded with a mixed native/non-native grass seed mix. The top of the berm would be compacted and topped with gravel. After excavation, the wetland would need to be lined with clay to assist in water retention. The interior of the wetland will be planted with tules *(scirpus acutus)* with cattails *(typha latifolia)* expected to be recruited naturally. Vegetation will be harvested and disposed of off site when it exceeds 50% coverage of the wetland. Water level in the wetland will be maintained between 2-3' in depth and be controlled by an overflow weir. Water entering into the wetland will first enter a sediment settling basin before flowing over a low weir into two cells. The sediment basin will be required to be cleaned out on a regular basis. The purpose for dual cells is the ability to drain one for maintenance and plant harvesting while still allowing the wetland to function. During maintenance operations, it can be expected that treatment capabilities will be slightly reduced. A long-term operations, management, and maintenance plan would be required for the entire system.

Further description of this measure can be found in the Bushy Lake Ecosystem Restoration Technical Study (December 2001) attached to this document, specifically in Chapter 5.

4.19.2 Issues of Significance

This measure addresses two significant issues affecting Bushy Lake and the Lower American River. Primarily, this measure will allow Bushy Lake to avoid fluctuating water levels with periods of dessication by creating a reliable, constant, and managed source of water. The new system will allow for water levels within the Lake to be managed to mimic a natural hydrograph with higher water levels in the spring and lower levels in the late summer. It also addresses the degraded quality of the water entering the Lower American River from Chicken Ranch and Strong Ranch Sloughs and the threat it poses to aquatic species, especially endangered native fish species, by filtering some of this water through a storage wetland.

4.19.3 Performance Standards

As part of a comprehensive operations, maintenance, and management plan for the storage wetland system, performance standards will need to be established to guide monitoring. In general, the wetland should be monitored for vegetation cover, nutrient uptake, contaminant removal, wildlife use, mosquitoes, and proper functioning of the lift pump.

4.19.4 Benefits

Habitat

The tules and cattails in the storage wetland will provide habitat to many native avian species.

Nonhabitat

Because clean water is a common goal of many local, state, and federal agencies for both wildlife and public health reasons, this measure would assist in meeting these goals. The storage wetland would also create excellent opportunities for further academic research into stormwater wetland treatment and design. The location of the wetland adjacent to the Cal Expo facilities would create an ideal opportunity to educate thousands of people each year about stormwater, watershed protection, and wildlife.

4.19.5 Costs

Costs (per acre)
Based on an equation developed by Brown and Shueler (1997), an estimate for the cost of a constructed wetland for stormwater can be based on the following equation: $C=30.6V^{(0.705)}$
This results in an estimated cost of $384,966.
Brown and Shueler's research also estimates that a maintenance cost runs about 3-5% of construction cost resulting in an annual cost of $19,250. Table 8-1 of the attached Technical Study lists proposed maintenance activities and schedule for the storage wetland.

Areas of Potential Applicability

Site	Areas in Site	Acreage
Bushy Lake	Between detention basin and Bushy Lake	6-10

Establishment Period

10 years for establishment, 50 years for full-functioning value.

Nonmonetary Costs

A nonmonetary cost of this measure would be the loss of approximately 1.5 acres of overflow parking used by Cal Expo during the state fair. It is likely that this acreage can be compensated with additional parking created offsite or immediately adjacent to and east of the existing parking area in an area that is currently ruderal grassland.

4.20 Measure 20. Improve the Flow of Water from Sump Pump No. 152 Eastward to Bushy Lake by Removing Metal Fence and Dredging the Channel Bottom to Reestablish a Low-Flow Channel.

4.20.1 Description of Actions

This measure consists of two principal actions. The first would be to excavate, remove, and dispose of the metal fence crossing the channel and to remove the debris and vegetation that has accumulated on the west side of the fence. The second component is to carefully recreate a meandering low-flow channel with positive drainage toward Bushy Lake. This can be achieved using a small tractor and manual labor where access by the excavator is limited by vegetation. The dredged material could be used to recreate flood plains in the channel or removed from the site.

4.20.2 Issues of Significance

The primary issue this measure addresses is water supply for Bushy Lake. At present, only major storm events provide flow to the lake. Reestablishing a meandering low-flow channel will allow even low summer flows from the sump pump to flow into Bushy Lake to supplement summer water supply and perhaps reduce its dependence on groundwater pumping from Cal Expo.

4.20.3 Performance Standards

Positive drainage from the sump pump outlet to Bushy Lake is the strongest indicator of the performance of this measure.

4.20.4 Benefits

Habitat

By adding more water to Bushy Lake during the summer months when it needs it most, this measure could potentially raise the surface water elevation of the lake, which will help suppress duckweed growth in the lake and cocklebur growth in the fingers of the lake.

Nonhabitat

No nonhabitat benefits have been identified for this measure.

4.20.5 Costs

The following tables identify the cost per acre of the measure and the range of acres at each site to which each measure could be applied.

Costs (per acre)	
Construction/startup:	$13,500 per acre
Mobilization:	$1,000 per acre
Earthwork:	$12,500 per acre
	(1 foot of cut @ $7.50/cubic yard)
Operations, maintenance, and monitoring:	$3,000 per acre

O&M interval: every 3 years

Areas of Potential Applicability

Site	Areas in Site	Acreage
Bushy Lake	Channel at toe of levee	1-3

Establishment Period

2 years for establishment; 10 years for full-functioning value.

Nonmonetary Costs

There is the potential for disturbance of small amounts of native plants to provide access into the channel for dredging.

4.21 Measure 21. Fill and Plant with Native Riparian Oak Woodland Species.

4.21.1 Description of Actions

Using excess material from excavations described in previous measures, raise the elevation of the flood plain to expand selected oak woodland habitat.

Plant the following species 30 feet on center. Tree species should be protected with plastic shelters.

Common and Scientific Names	Size
Valley oak (*Quercus lobata*)	50 percent acorns/50 percent 1 gallon
Interior live oak (*Quercus wislizenii*)	50 percent acorns/50 percent 1 gallon
Blue oak (*Quercus kelloggi*)	50 percent acorns/50 percent 1 gallon
Black walnut (*Juglans hindsii*)	1 gallon
Coyote bush (*Baccharis pilularis*)	1 gallon
Elderberry (*Sambucus mexicana*)	1 gallon

Irrigate for 2 years using slow-release polymer gel cartridges. Maintain for 5 years by keeping weed free, replacing dead plants, and replacing the gel cartridges and tree shelters as necessary.

4.21.2 Issues of Significance

Much of the existing oak woodland lies in small, fragmented remnant patches. Larger, connected expanses of oak woodland would provide better wildlife habitat in a few selected areas.

4.21.3 Performance Standards

Sustaining planted oaks will rely heavily on supplemental irrigation for the first several years. The density of the planting factors in a loss of 10-15 percent of oak species. A minimum of 80-percent survival of planted oak species after 10 years is recommended.

4.21.4 Benefits

Habitat

The size of oak woodland areas would be enlarged providing better cover, shelter, and nesting habitat for migratory songbirds and native wildlife.

Nonhabitat

Oak woodlands are becoming increasingly scarce in the metropolitan region. Implementing this measure would allow for the creation of oak woodland in the Sacramento metropolitan area.

4.21.5 Costs

The following tables identify the cost per acre of the measure and the range of acres at each site to which each measure could be applied.

Costs (per acre)	
Construction/startup:	$53,000 per acre
Mobilization:	$1,000 per acre
Earthwork:	$50,000 per acre
	(4 feet of fill @ $7.50/cubic yard)
Planting:	$1,000 per acre
Irrigation:	$1,000 per acre
	($20/plant/year @ 50 plants/acre for hydrating gel supplements)
Operations, maintenance, and monitoring:	$3,000 per acre for first monitoring year (for hydrating gel supplements); $2,000 per acre per year thereafter.

O&M interval: 5 years during the first 10 years; once every 5 years thereafter

Areas of Potential Applicability

Site	Areas in Site	Acreage
Arden Bar	Along maintenance road	2-3.5

Establishment Period

10 years for establishment; 50 years for full-functioning value.

Nonmonetary Costs

No nonmonetary costs have been identified for this measure.

4.22 Measure 22. Plant Banks of Proposed High-Flow Bypass Channel with Willow Species.

4.22.1 Description of Actions

Plant 24-inch willow cuttings within cobble banks of bypass channel. No irrigation would be required. This measure would be done only in conjunction with Measure 14.

4.22.2 Issues of Significance

This measure intends to increase bank stability of the proposed bypass channel while increasing its habitat value.

4.22.3 Performance Standards

The willow cuttings should have a survivability rate of 80 percent after 5 years.

4.22.4 Benefits

Habitat

Mature willows would provide shelter and nesting habitat.

Nonhabitat

This measure would assist with the structural integrity of the banks of the high-flow bypass channel.

4.22.5 Costs

The following tables identify the cost per acre of the measure and the range of acres at each site to which each measure could be applied.

Costs (per acre)	
Construction/startup:	$2,500 per acre
Mobilization:	$1,000 per acre
Planting:	$1,500 per acre
Operations, maintenance, and monitoring:	$1,500 per acre

O&M interval: 5 years during the first 10 years; once every 5 years thereafter

Areas of Potential Applicability

Site	Areas in Site	Acreage
Arden Bar	Edges of proposed high-flow bypass channel	0-4.5

Establishment Period

5 years for establishment; 50 years for full-functioning value.

Nonmonetary Costs

No nonmonetary costs have been identified for this measure.

4.23 Measure 23. Create Shallow Aquatic Habitat at the Outlet of the Proposed High-Flow Bypass Channel to Create Permanent Lentic Habitat for Native Fish Species.

4.23.1 Description of Actions

The intent of this measure is that it be constructed in conjunction with Measure 14. This area should be graded to 1-3 feet below the low-water elevation to provide permanent backwater.

4.23.2 Issues of Significance

Anadromous species need slow water located off the main channel for resting during their migration upstream. Many of these side channels and shallow aquatic areas along the Lower American River have been depleted as a result of changes in the river channel created from hydraulic mining and the construction of upstream dams.

4.23.3 Performance Standards

The shallow aquatic habitat should be monitored annually for use by fish and for stability of the banks to ensure that no sedimentation of the shallow aquatic area is occurring.

4.23.4 Benefits

Habitat

This measure addresses specific needs of the endangered anadromous fish species. It could assist in the recovery and return of these species to the American River system.

Nonhabitat

No nonhabitat benefits for this measure have been identified.

4.23.5 Costs

The following tables identify the cost per acre of the measure and the range of acres at each site to which each measure could be applied.

Costs (per acre)	
Construction/startup:	$67,500 per acre
Mobilization:	$1,000 per acre
Earthwork:	$62,500 per acre
	(5 feet of cut @ $7.50/cubic yard)
Planting:	$4,000 per acre
Operations, maintenance, and monitoring:	$1,500 per acre

O&M interval: 5 years during the first 10 years; once every 5 years thereafter

Areas of Potential Applicability

Site	Areas in Site	Acreage
Arden Bar	Outlet of proposed high-flow bypass channel	0.5-0.75

Establishment Period

5 years for establishment; 50 years for full-functioning value.

Nonmonetary Costs

No nonmonetary costs for this measure have been identified.

4.24 Measure 24. Remove Levee from around Sheriff's Training Facility and Reuse or Dispose of Material.

4.24.1 Description of Actions

Excavate the levee material from around the sheriff's training facility and dispose of the material at an appropriate facility. To minimize disposal, material would be reused and graded within the boundaries of the site, including placement of fill on the pond to reduce its size and on specific areas designated for oak woodland.

4.24.2 Issues of Significance

The levee is a nonconforming use in the Parkway, and it is an obstacle for larger, terrestrial wildlife in the corridor. This measure would assist in restoring hydrological processes by allowing occasional high flows to pass through this area. Removal of the levee would allow for the study of the sheriff's training facility land as a suitable location for restoration or additional parkland.

4.24.3 Performance Standards

Complete removal of the levee and regrading to achieve a similar surface elevation as that on the outside of the levee is an appropriate standard for measuring success of this item.

4.24.4 Benefits

Habitat

The primary habitat value of this measure is the expansion of the wildlife corridor.

Nonhabitat

This measure would add additional usable acres to the Parkway and remove a nonconforming use in the Parkway.

4.24.5 Costs

The following tables identify the cost per acre of the measure and the range of acres at each site to which each measure could be applied.

Costs (per acre)	
Construction/startup:	$77,000 per acre
Mobilization:	$1,000 per acre
Earthwork:	$76,000 per acre
	(10 feet of cut @ $7.50/cubic yard)

Areas of Potential Applicability

Site	Areas in Site	Acreage
Arden Bar	Around Sheriff's Training Facility	9.0

Establishment Period

Not applicable.

Nonmonetary Costs

No nonmonetary costs for this measure have been identified.

4.25 Measure 25. Install Pump and Delivery System to Divert Flows from Chicken Ranch and Strong Ranch Sloughs to the Bushy Lake (Cal Expo) Flood Plain.

4.25.1 Description of Actions

This measure should be considered only in conjunction with Measure 18 and 19 for the Bushy Lake site. An 1800 rpm, 20 hp lift pump would be installed on the levee on the north bank of the levee between the flood plain and the detention basin. The pump would divert flows from Chicken Ranch and Strong Ranch Sloughs and pipe them approximately 3,500' into the storage wetland system (Measure 19).

4.25.2 Issues of Significance

The two issues driving this measure are the ecological decline of Bushy Lake and the quality of water presently entering the Lower American River from Chicken Ranch and Strong Ranch Sloughs.

4.25.3 Performance Standards

The proper operation of the pump delivery system should be monitored monthly to ensure that it is pumping and delivering an appropriate amount of water from the sloughs.

4.25.4 Benefits

Habitat

The primary benefit of this measure would be to assist in the restoration of a more natural hydrological process to Bushy Lake. In conjunction with Measure 19, this measure would also assist in improving the quality of the wetlands and, in effect, the water in the Lower American River.

Nonhabitat

This measure could assist local, state, and Federal agencies in meeting clean water goals intended to protect public health and fish species.

4.25.5 Costs

The following tables identify the cost per acre of the measure and the range of acres at each site to which each measure could be applied.

Costs (per acre)	Estimated Quantity	Unit	Unit Price	Total
Pump Structure	26	CY	600	$15,600
Pump (1800 RPM)	1	EA	9,000	9,000
Metal Trash Rack	15	SF	100	1,500
Metal Grating	24	SF	25	600
Ladder Rungs	19	EA	50	950
RC Outlet Structure	4	CY	600	2,400
16” Flap gate	1	EA	1,500	1,500
Motor (20 HP)	1	EA	3,000	3,000
16” Steel Pipe	50	LF	50	2,500
16” PVC Pipe	2,530	LF	30	75,900
Siphon Breaker Valve	1	EA	1,000	1,000
12/16 Pipe WYE	1	EA	1,000	1,000
12” Check Valve	1	EA	2,800	2,800
16” Check Valve	1	EA	5,800	5,800
Bubbler System	1	EA	4,000	4,000
Trench Excavation	1,055	CY	5	5,300
Pipe Bedding	395	CY	10	4,000
Trench Backfill	585	CY	3	1,800
Electrical				$70,000
Mobilization				$15,000
Documentation				$20,000
Contingency (15%)				$39,743
Total				$304,693

Note: Under contract with the Sacramento Area Flood Control Agency, Parsons Brinckerhoff completed the above cost estimate (11/01).

Areas of Potential Applicability

Site	Areas in Site	Acreage
Bushy Lake	Northeast, levee between detention basin and flood plain	0.5

Establishment Period

Not applicable.

Nonmonetary Costs

No nonmonetary costs for this measure have been identified.

SECTION 5.0

LIST OF PREPARERS

Name/Expertise	Experience	Role in Preparation
Sharon McHale	1 year of experience as an environmental manager, U.S. Army Corps of Engineers; 1 year of experience as a project planner, U.S. Army Corps of Engineers; 10 years of experience as an environmental planner, Sacramento County	Report preparation and review
Thomas Adams	15 years of experience as a water resources planner, U.S. Army Corps of Engineers	Report review
Patricia Roberson	14 years of experience in water resources studies, U.S. Army Corps of Engineers	Report review
Chris Elliott Landscape Architect	7 years of experience in landscape planning, Jones & Stokes	Report preparation and review
Brian Higgins Restoration Planner	2 years of experience in landscape planning, Jones & Stokes	Report preparation
Sheri Brown Restoration Planner	9 years of experience in landscape planning, Jones & Stokes	Report preparation
Gabriel Roark Cultural Resource Expert	5 years of experience in cultural resource analysis, Jones & Stokes	Report preparation
Ken Casaday Senior Restoration Planner	15 years of experience in riparian restoration planning, Jones & Stokes	Report review
Richard DeHaven Biologist	15 years of experience in biological studies, U.S. Fish and Wildlife Service	HEP analysis

SECTION 6.0

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